the OIL AND GAS JOURNAL

OCTOBER 24, 1955

How Texas Gas Redesigned To Boost Naphtha Octanes p. 78

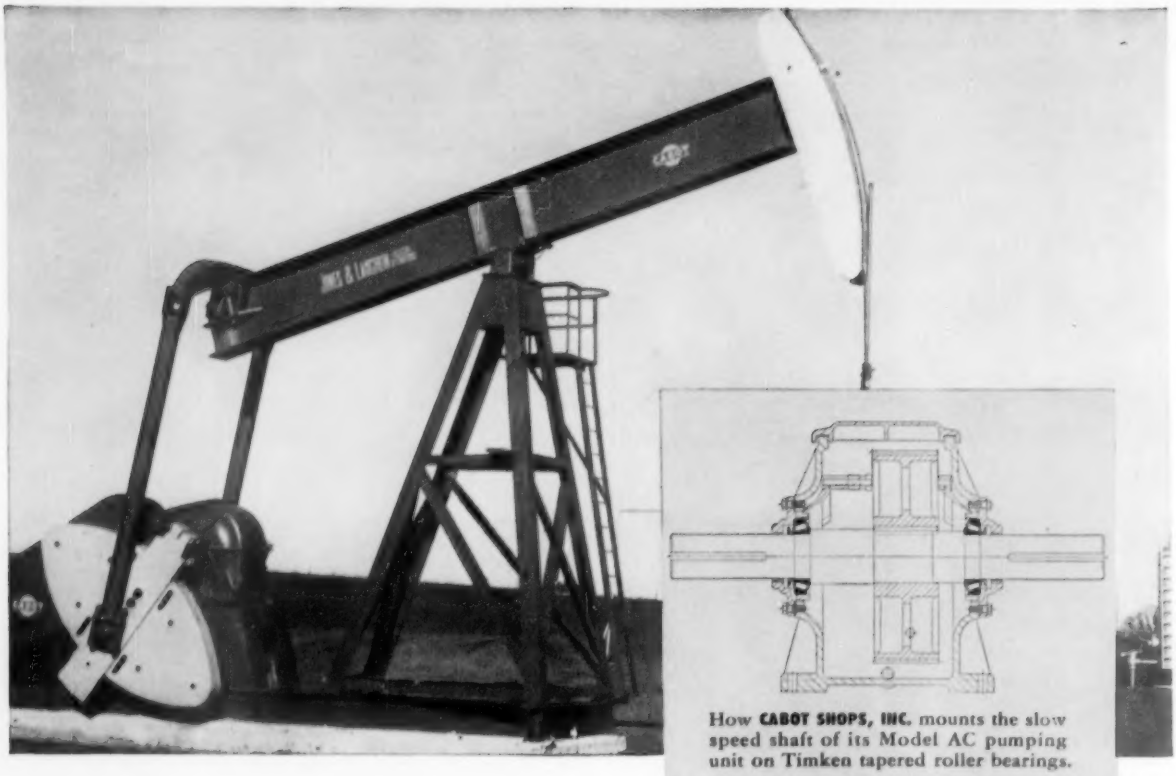
Profits From Water Flood Depend on Proper Controls p. 82

Wire-Line Life Is Matter Of Good Cutoff Practice p. 103

Payout for Spraberry

The Clear Fork is no great shakes as a pay zone, but it promises to put a lot of operators in the black.

p. 56



How **CABOT SHOPS, INC.** mounts the slow speed shaft of its Model AC pumping unit on Timken tapered roller bearings.

How TIMKEN® bearings hold shafts in alignment despite heavy loads— cut gear wear on Cabot pumping unit

THE bearings on the slow speed shaft on this Cabot Shops, Inc. Model AC pumping unit face real problems. Since herringbone gears are used, the bearings must position all shafts. And since they're on the slow speed shaft, they must take heavy radial loads. To add to the problem, this equipment must run for years with very little attention. So the bearings must be practically maintenance-free.

To solve these problems, Cabot engineers specified Timken® tapered roller bearings in each gear box. Timken bearings are designed to do such tough jobs easily. Full line contact between rollers and races gives them greater load-carrying capacity. And tapered design lets Timken bearings take *both* radial and thrust loads or any combination. As a result, end play is minimized. Shafts are held in proper alignment. Gear wear is reduced. Because Timken bearings hold housings and shafts concentric, closures are more effective. Lubricant stays in—dirt and moisture stay out. Lubrication costs are kept way down.

One reason Timken bearings can take it month in and month out is that we make our own bearing steel. We're America's only bearing manufacturer that does. And we make the steel nickel-rich for added toughness.

To make sure you get all these advantages, specify Timken bearings on all the oil field equipment you build or buy. Look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

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Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

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A glance ahead . . . at press time

These trends will make TOMORROW'S NEWS

Formation fracturing of gas wells in San Juan basin is bringing area's gas deliverability up to pipeline requirements much faster than had been anticipated when El Paso expansion and new Pacific Northwest lines were planned. It means that far fewer wells will be drilled during initial stages of development.

Ownership of oil and gas rights on lands originally given land-grant railroads may be headed for gigantic court battle. Terms of grants vary among roads but some lines are already involved in litigation.

Rumors have it that a big-name eastern law firm is preparing a smash case to prove that at least one railroad doesn't own the mineral rights it has already leased to oil operators.

Most thorough study ever made on cost of finding and producing oil, nearing completion by group of trade associations, will provide material to support depletion tax allowance. Will also provide ammunition for arguments over imports, and to justify higher crude and gas prices.

Some drilling companies are considering using new high-strength tubing as drill string for routine drilling, not just slim holes. Is cheaper and lighter than drill pipe of same diameter, can stand as much pulling load and almost as much torque. Tubing up to 4-in. diameter has been tried successfully.

Several West Coast oil companies are preparing to start extensive stratigraphic drilling programs in California's coastal waters. Slim-hole drilling will be performed from converted mine sweepers and similar vessels equipped with light core-drilling rigs. New type submarine equipment will permit drilling from the floating barges.

Gas producers everywhere and conservation bodies of other states are watching with great interest the current efforts of Texas and Louisiana commissions to control gas withdrawals and field prices.

If practical regulatory procedures are evolved, courts may uphold states' rights in this area against encroachment of federal control, whether or not Harris bill is enacted.

International gas exchange plan of Trans-Canada and Tennessee Gas Transmission may stir up one of the biggest hassels ever to come before FPC.

If potential opponents choose to fight, they could force some important policy decisions—heretofore skirted by FPC—over fuels competition, invasion of markets, allocation of service areas.

the OIL AND GAS JOURNAL

OCTOBER 24, 1955 • VOLUME 54 • NUMBER 25

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TECHNOLOGY—OPERATION

Texas Gas Corp. Upgrades Naphtha Octanes 78

By F. Lawrence Resen

Texas Gas Corp. is now upgrading straight-run naphtha to high-octane motor fuels at its Winnie, Tex., plant. With the installation of a 2,500-bbl.-per-day Platformer, pool octane number has been upped from 86.5 to 93.5. This step enables Texas Gas to move into the field of light refining operations.

How to Increase Water-Flood Profits 82

By Robert R. Hawkins

Water for flooding needs proper treatment. These factors should be controlled: (1) suspended matter; (2) chemical precipitation; (3) algae and bacteria; (4) corrosion; (5) clay swelling; and (6) surface forces. Cost of injection and cost of production are then decreased. Total oil produced and profits are increased.

Mass-Spectrometer Analyses for Hydrocarbons in Drilling Mud 86

Here's A Mud Desander that Cuts Drilling Costs 87

By D. E. Wuth and R. L. O'Shields

A new mud desander is being used to continuously remove sand from drilling mud during drilling operations. It requires little supervision or maintenance and reduces sand volume of muds to about 0.2 per cent. In Southwest Louisiana wells, the desander has saved operators $2,700 to $3,300 per well.

Why Did Those Catalyst Storage Vessels Fail? 89

By F. Lawrence Resen

Here is a detailed metallurgical study made of the regenerated-catalyst hopper and spent-catalyst vessels at one of Humble's fluid catalytic cracking units. These vessels failed after several years of operation. This is the final article in a series of four from the work of Humble's Baytown refinery metallurgical group.

Here's the Economics of Cathodic Protection of Tank Bottoms 95

By J. J. Meany, Jr.

Stray currents and a cinder fill complicated protection of two storage tanks dealt with by the author's company. But planning the protection system before the tanks were built allowed burying anodes and reference electrodes beneath the tanks, thus greatly simplifying the problem.

Good Cutoff Practices Will Save Drilling Lines 103

By Ed McGhee

Here are data on rotary drilling lines used in West Texas. Under almost identical conditions, three lines were put in service and careful records kept on each before it was retired. The line with the poorest cutoff practice gave only half the service given by the line with the best cutoff practice.

With the MicroLog—You Can Be Sure 106

By Maurice Martin

The MicroLog can be used to determine porosity, oil saturation, the index of producible oil of permeable formations, and to locate oil-water or gas-water contacts. This article tells how. In a previous article, it was shown how the MicroLog can be used to identify different types of formations.

Pipeline Patrol: Controlling Pulsations in Gas-Piping Systems 117

By C. Newman and N. H. Moerke

This article gives the general characteristics of pulsation dampeners and advantages of each.

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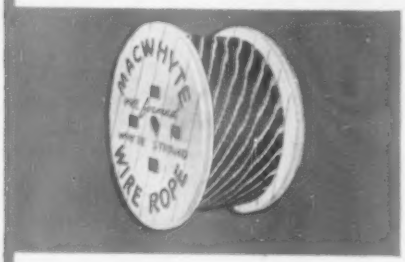

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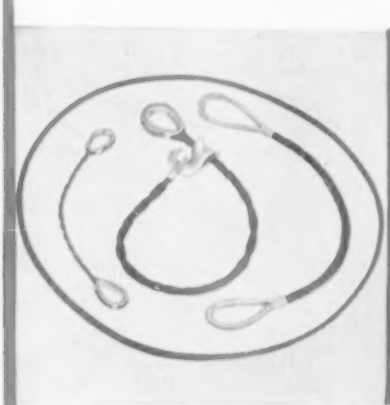

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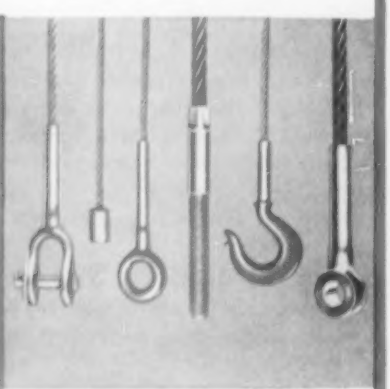
WIRE ROPE: There is a right rope for each equipment need. Catalog G-16 lists all classifications and sizes, also included is general information on handling and use of wire rope.



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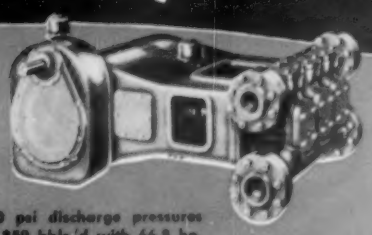

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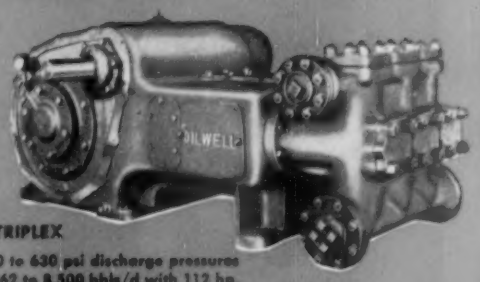

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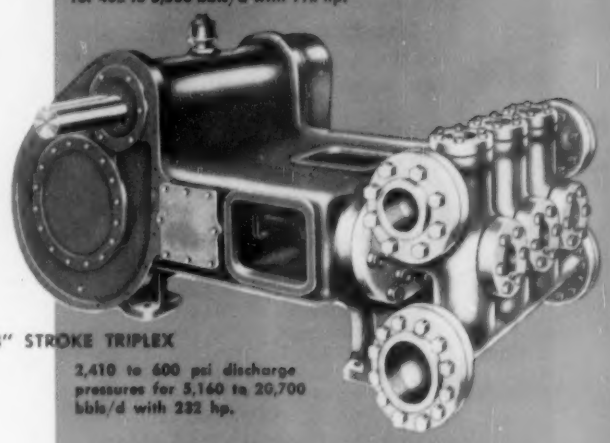

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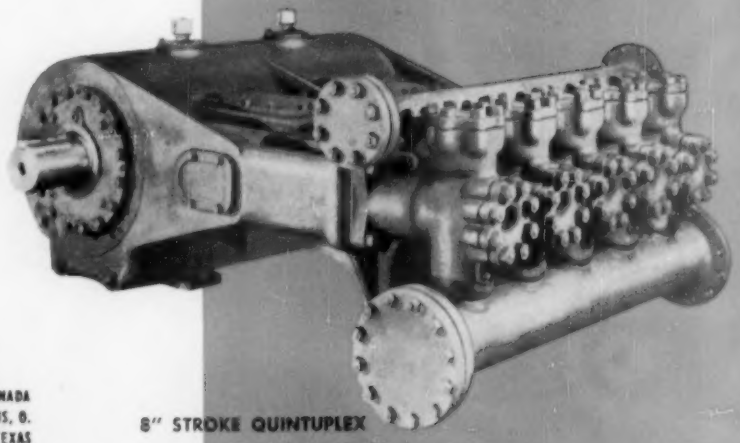

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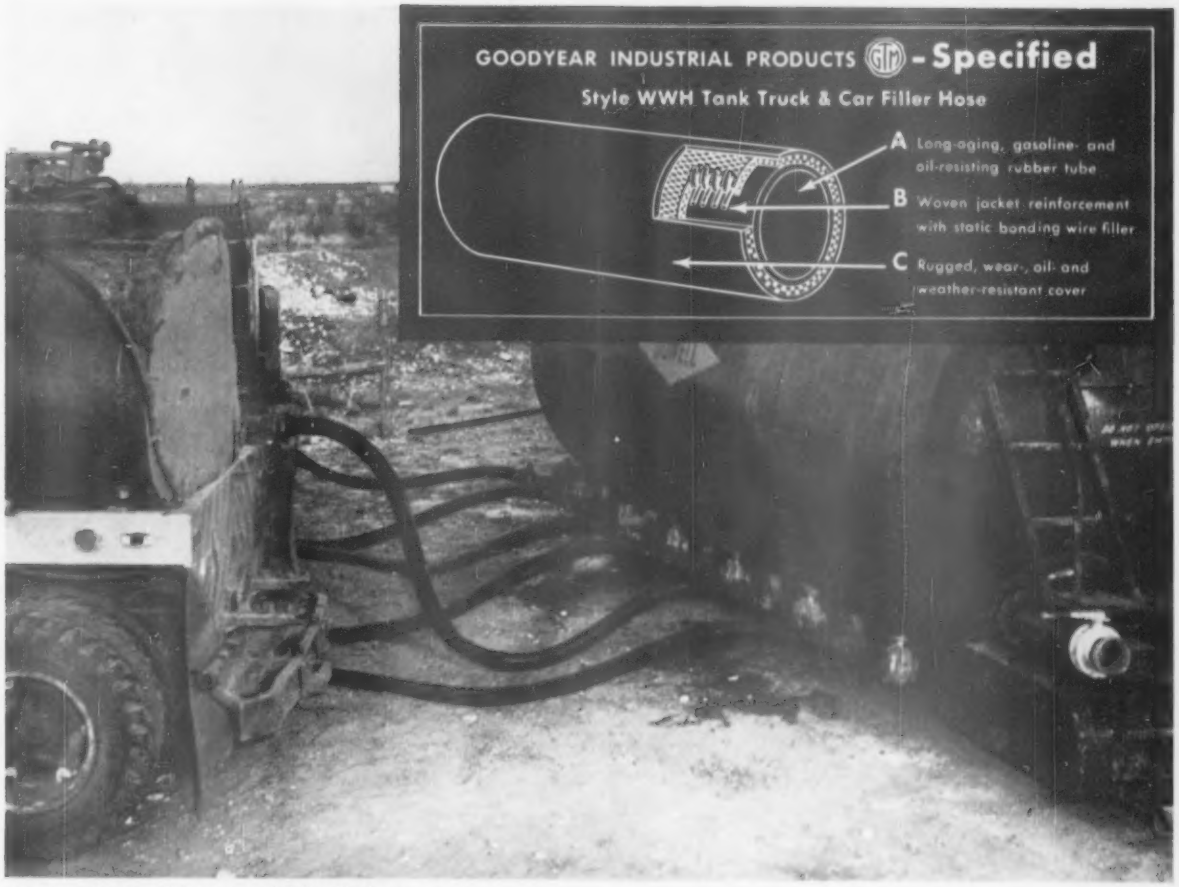
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Photo courtesy Dowell Incorporated, Tulsa, Oklahoma

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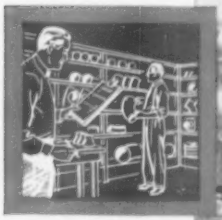

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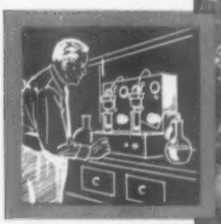

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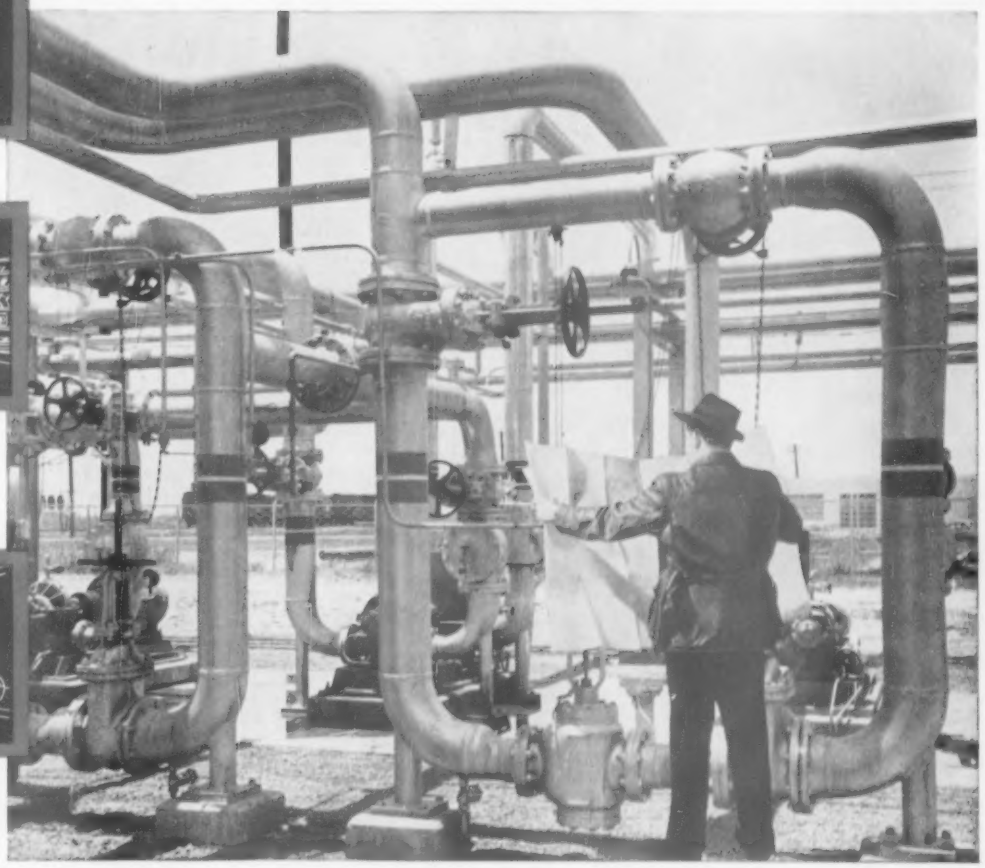

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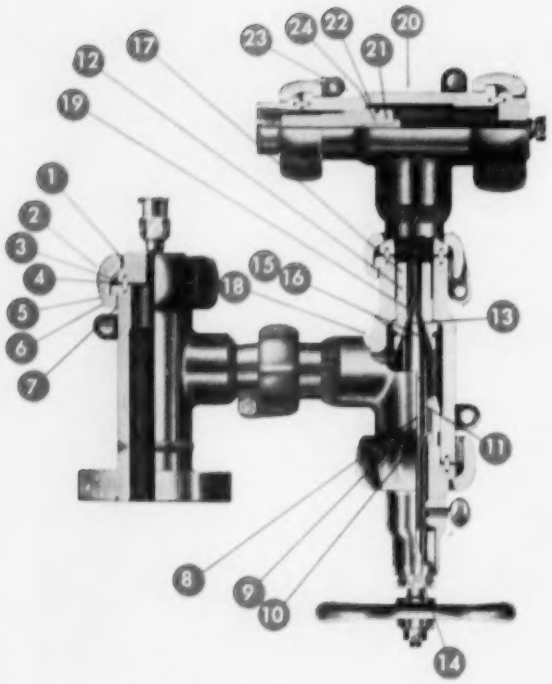

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Superior Diesel or Dual Fuel Drilling Engines are available from 300 to 650 Continuous B.H.P. Superior Gas Drilling Engines from 320 to 630 Continuous B.H.P.

Dependable Superior Diesels practically eliminate costly down-time. With minimum maintenance and repairs, they'll power your rig for many more hours between overhauls, under the most rugged, toughest field service! Hundreds of case histories are firm proof too, that Superior's precision construction cuts fuel and lubrication costs to a bare minimum. Dynamically balanced crankshafts provide practically vibration-free operation at all speeds . . . this enables rapid acceleration for quicker round trips and for fast pipe handling . . . and relieves excess wear on all engine accessories.

Make a Superior investment . . . get all the facts from leading rig manufacturers, or through White Diesel field representatives available in all oil field areas or through the White Diesel Engine Division. You'll see convincing proof Superior Diesels are your best investment! And you can continue to invest with confidence because the vast facilities of the White Motor Company are dedicated to carry on intensified research, development and precision manufacturing of Superior and Atlas Diesel, dual fuel, and gas engines for oil field service.

WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY • *Plant and General Offices: Springfield, Ohio*

Superior ENGINES ATLAS Imperial DIESEL ENGINES White DIESEL

Now

LOWEST COST APPROVED LIGHTING SYSTEM! New Crouse-Hinds Type EVA Fixtures cost less to buy, install and maintain. No special installation or maintenance operations required. No pressure switch to fail and possibly create a hazardous condition. You'll get sustained performance at top economy with these new lighting fixtures. 200 W; with or without guard or reflector; overall length, 13-3/16".

Complete, explosion-proof lighting installations for acetylene & hydrogen areas!

CROUSE-HINDS CONDULETS®

UL Approved for Groups A and B Locations

- The first complete lighting system designed and UL-approved for Class 1, Groups A & B hazardous locations.
- New lighting fixture can be re-lamped even in the presence of combustible gases: gas-tightness not required for its safe performance.
- Heavy, shock-resistant construction withstands pressures from internal explosions without rupturing.
- Flame-tight joints prevent escape of flame to flammable atmosphere.

Whether you're installing a complete explosion-proof lighting system – or merely converting a few of your Group C or D fixtures to these safer Group A's – Crouse-Hinds provides greatest safety and economy. See your Crouse-Hinds distributor, or write us.

Explosion-proof Tumbler Switch Condulets

Explosion-proof Junction Condulets

Explosion-proof Sealing Condulets

Explosion-proof Flexible Couplings

Explosion-proof Conduit Unions

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

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OFFICES: Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Memphis, Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., St. Louis, St. Paul, San Francisco, Seattle, Tulsa, Washington. REGIONAL REPRESENTATIVES: Albany, Atlanta, Baltimore, Baton Rouge, Charlotte, Chattanooga, Corpus Christi, Reading, Pa., Richmond, Va., Shreveport. Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONDULETS • FLOODLIGHTS • TRAFFIC SIGNALS • AIRPORT LIGHTING

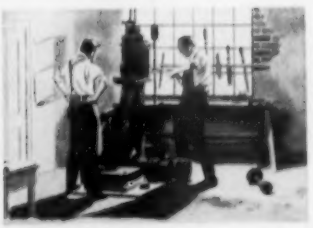
Leader in Lubrication

THEN

The first successful plane, developed by Wilbur and Orville Wright, took off December 17, 1903. On this famous flight *Mobiloil* protected the engine of the Wrights' tiny biplane.

Early racing champion, Ralph DePalma, drove to fame on old-time dirt tracks. In 1915 this two-time National AAA Winner set Indianapolis Race record of 89 mph *with Mobiloil!*

1909 Blue Ribbon Holder, H.M.S. Mauretania, held the North Atlantic speed record for 22 years. Like every Blue Ribbon winner since, she was protected by the *makers of Mobiloil!*



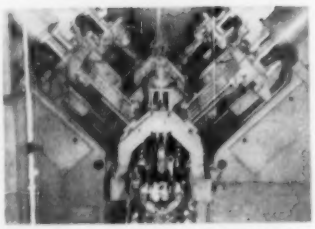
The first Diesel engine was developed in Germany in 1897. Rudolph Diesel, the inventor, solved his lubrication problem with special oils developed by the *makers of Mobiloil!*

NOW

Today's modern planes fly thousands of non-stop miles . . . travel coast to coast in hours. Socony Mobil helped make this rapid progress possible by continually developing the right fuels and lubricants.

1955 Indianapolis Winner, Bob Sweikert, averaged a sensational 128.209 mph to win this 500-mile classic. He relied on *Mobiloil*— first choice of more drivers than any other brand.

World's First Atomic Powered Submarine, the "Nautilus," is dramatic evidence of a new age. Socony Mobil supplied the Gargoyle Marine Oils that helped in the development and operation of this undersea marvel.



Modern industry's new trend— manufacture through automation— depends on precise hydraulic control. Majority of automated plants call on Socony Mobil's 89 years' experience.

SOCONY MOBIL OIL COMPANY, INC.

Makers of

Mobiloil
World's Largest-Selling Motor Oil

Mobiloil Special
America's Most Popular Year-'round Motor Oil

Case history of Axelson pump performance—
A $300 Axelson Deep Well Pump has produced over $2,000,000 worth of oil without a single pulling job! Here is a report from the oil company: "An Axelson 2½" x 2¼" x 11' tubing liner pump produced approximately 1,000,000 barrels of oil over a ten year period from a Tensleep well in West Central Wyoming. It was operating at an over-all efficiency of 90 percent at the time it was pulled to check for slippage, which was believed to be causing tight emulsion."

Here's why: Axelson's 63 years experience in the manufacture of Deep Oil Well Pumping equipment has clearly indicated the need for tailoring pump parts to resist specific well conditions. Wise operators call in Axelson field experts for well analysis and the specification of the correct equipment for trouble-free operation.

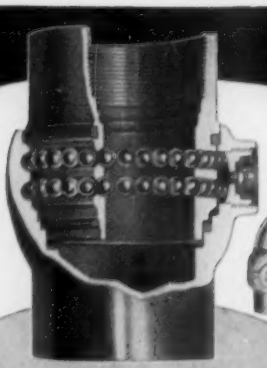
AXELSON
Deep Well Pumps

Send for Pump Information

AXELSON MANUFACTURING COMPANY • DIVISION OF U. S. INDUSTRIES, INC. • LOS ANGELES 58, NEW YORK 7, TULSA 1, ST. LOUIS 16
GENERAL OFFICES: P.O. BOX 58335 VERNON STATION, LOS ANGELES 58

DISTRIBUTORS—Jones & Laughlin Steel Corp., Supply Division; Great Northern Tool & Supply Company; Jones & Laughlin Steel Sales Co., Ltd., Supply Division, Edmonton, Alberta, Canada; Dominion Oilfields Supply Co., Ltd., Calgary, Alberta, Canada; Adrian Bolland & Cia., S.R.L., Buenos Aires, Argentina, S.A.; Gross Equipment S.A., Lima, Peru, S.A.; Industrial Agencies, Ltd., San Fernando, Trinidad, B.W.I.; MAQUIP (Comercial de Marquinas e Equipamentos) S.A., Rio De Janeiro, Brazil, S.A.; Servicios Industriales, C.A., Barcelona, Venezuela, S.A.; Servicios Industriales, C.A., Maracaibo, Venezuela, S.A.; Wells Fargo & Co. Express, S.A., Mexico, D.F.

STEEL
BRONZE
MONEL
ALUMINUM



OPW
swing joints

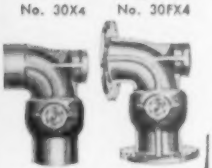
FULL UNRESTRICTED FLOW • EFFORTLESS MOVEMENT
GREATER LOAD CARRYING CAPACITY • "O" RING SEALED
CONTAMINATION FREE OPERATION • PERFECT ALIGNMENT

The wide range of sizes and styles of OPW BALL BEARING SWING JOINTS offers many and varied applications for safely handling liquids of diversified viscosity at required temperatures and working pressures.

Millions of gallons of all types of liquids are moved daily in flow lines where perfectly sealed, rotating OPW Swing Joints provide an almost limitless range of flexible operations.

Join other users of OPW Swing Joints. You can also realize economies in your liquid products handling.

Free Catalog F-8
provides engineering data, sizes, styles, recommendations and prices.



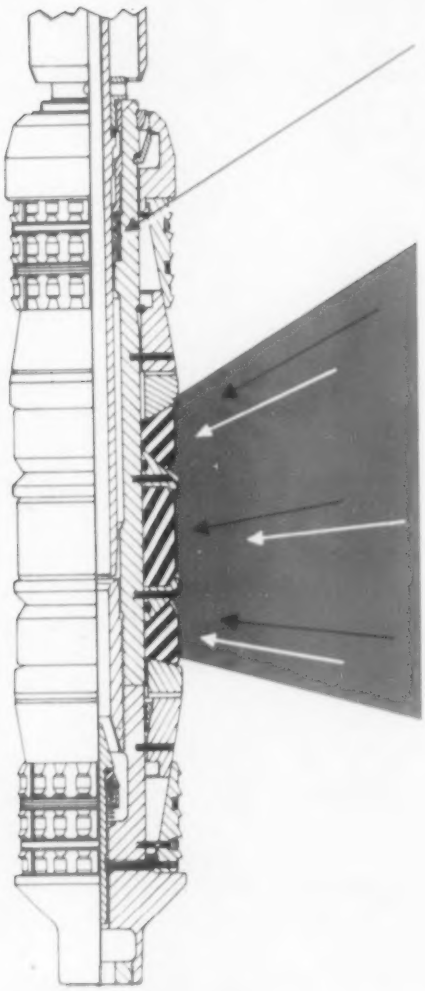
SWING EASY!

FLOW EASY!

OPW CORPORATION
FOR HANDLING HAZARDOUS LIQUIDS
OPW
VALVES • FITTINGS • ASSEMBLIES
CINCINNATI 25, OHIO

OPW CORPORATION 2731 COLERAIN AVE., CINCINNATI 25, OHIO

PROVIDES DEPENDABLE SEAL
under deephole conditions



DM PACKER — High strength, drillable magnesium alloy for squeezing, temporary bridge plugs and fast drilling out.

DC PACKER — High strength, drillable cast iron for squeezing and permanent bridge plugs.

HALLIBURTON'S
DM AND DC
SQUEEZE PACKERS

The punishing conditions in deep hole squeezing are mastered by Halliburton's rugged DM and DC Squeeze Packers. Designed to give a tight plug under high pressures and temperatures, they will withstand any condition that tubing and casing can safely handle!

A new internal seal, a new stabilized center packer and a harder, higher strength material for end packers give DM and DC Squeeze Packers more positive sealing qualities. These consistently dependable tools also feature a new location of the Internal Slips which further reduces any tendency of the packer to move upward during a cement job. And these new features retain the simplified setting procedure — a positive mechanical action of rotating tubing to the right. Be sure of getting positive action and a dependable seal that means a tough job completed with the utmost efficiency and economy. Specify DM and DC Squeeze Packers on your next squeeze job. Call your local or district office of the Halliburton Oil Well Cementing Company.

COMPLETE DATA SENT ON REQUEST

Get this valuable information for your Halliburton Service File.

HALLIBURTON

CEMENTING SERVICES

250 SERVICE CENTERS — JUST MINUTES AWAY FROM ANY RIG

...thank you for your service

Oil Center Tool Company
Shreveport, Louisiana

Attention: Mr. Herb Stewart

Gentlemen:

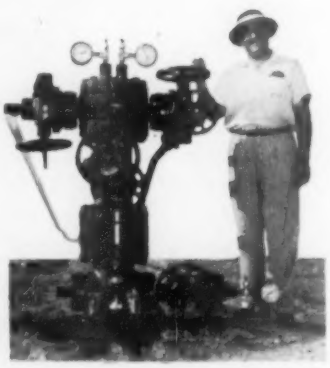
This is to advise you that I am gratified and pleased with my O-C-T Dual Christmas Tree. Everything worked perfectly, and I wish to thank you for your service and O-C-T for manufacturing this head for me in this connection.

I strongly recommend it to anyone making dual completions for safety, economy and efficiency.

If I should have occasion to use this on my next well, I will appreciate your taking care of me as you have on my No. 4 Smith Lindsey well. I have completed a nice gas well and a splendid oil well through this tree, 100%.

Very truly yours,

B. B. Orr
Longview, Texas



This unsolicited letter from Mr. B. B. Orr is further testimony to the fact that . . . if you make a dual completion . . . it will pay you to make it O-C-T. Dual completion equipment was pioneered and introduced **first** by O-C-T as early as 1941. O-C-T Dual Trees provide you with substantial savings. If you are considering dual completions, ask your nearest O-C-T representative for details on this safe, strong and practical means to your economic goals.

OIL CENTER TOOL COMPANY

SMALL BUT MIGHTY BIG!

It's just a simple hex nut—but it can easily prove vitally important to the successful completion or the efficient operation of a single unit or a complete processing plant.

That's just a good reason why careful attention to every detail of construction is highly significant to Procon. Constant alertness to the proper application of every component part—making sure that nothing is left to guesswork—results in better all-around construction.

Perhaps the best proof of such construction efficiency is most adequately evidenced by the number of companies that have selected Procon to handle a second, third and even a fourth construction project.

It's that kind of confidence that makes us realize even the smallest nut may prove a mighty big factor in our continued progress.

PROCON *Incorporated*
1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U. S. A.

PROCON *(Canada)* LIMITED
40 ADVANCE ROAD, TORONTO 18, ONTARIO

PROCON *(Great Britain)* LIMITED
112 STRAND, LONDON, W. C. 2

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL AND CHEMICAL INDUSTRIES

Power Products engines now equipped with special design

Bendix MAGNETOS

It's no secret that dependable, smooth performing engines require dependable, high quality components. That's why Power Products engines, widely used on lawn mowers, chain saws, garden tractors and other applications, are now being equipped with new-type Bendix Flywheel Magnetos.

These magnetos, specially designed for lightweight application, bring to Power Products engines many outstanding new advantages. In addition to an aircraft quality coil, this new magneto is equipped with a dust cover furnishing complete protection to the cam and breaker points from sawdust, dirt, grass clippings or other foreign matter. Then, too, a specially developed "TUMRON" cam boasts a satin finish minimizing wear and yet is porous enough to retain a permanent film of oil on the surface. This, in conjunction with a new nylon material follower, provides longest life-breaker operation.

Here is just one more example of Bendix's ability to produce a magneto to fit a particular application. That's why, like Power Products, it will pay you to bring your ignition requirements to Bendix—the most trusted name in ignition.

Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

FACTORY BRANCH OFFICES:

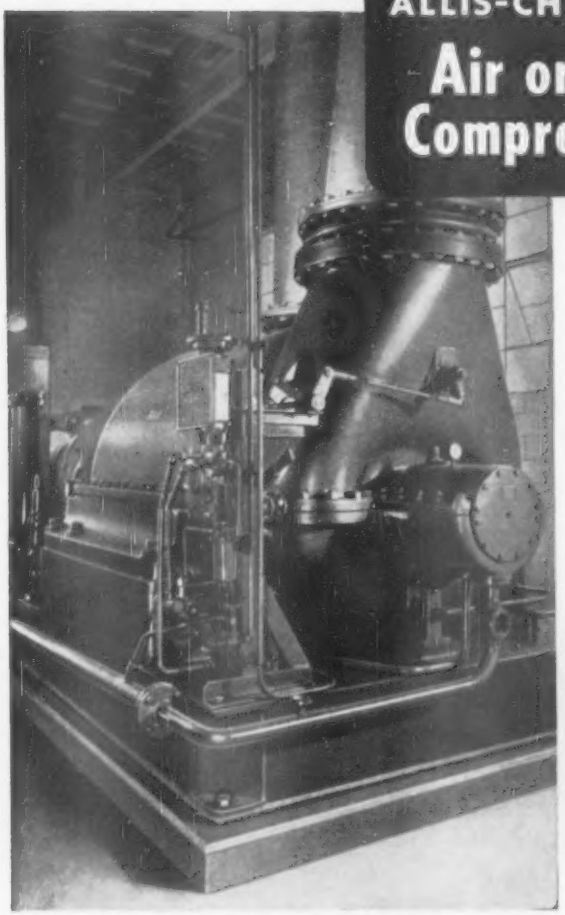
117 E. Providencia Avenue, Burbank, California • 512 West Avenue, Jenkintown, Pennsylvania • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan 5906 North Port Washington Road, Milwaukee 17, Wisconsin • American Building, 4 S. Main St., Dayton 2, Ohio • 8401 Cedar Springs Road, Dallas 19, Texas Boeing Field, Seattle 8, Washington • 1701 "K" Street, N. W., Washington 6, D. C.

Bendix
SCINTILLA DIVISION

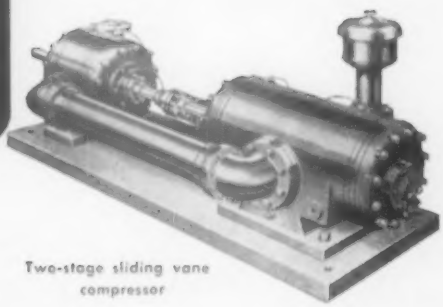
Bendix
AVIATION CORPORATION

ALLIS-CHALMERS

Air or Gas Compressors

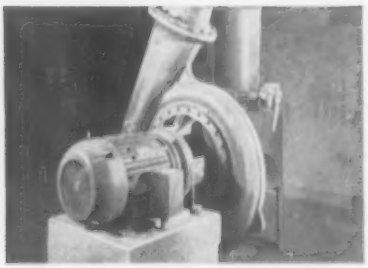


Four-stage motor-driven regenerator air compressor rated 28,000 cfm inlet volume at 26 psig discharge pressure.

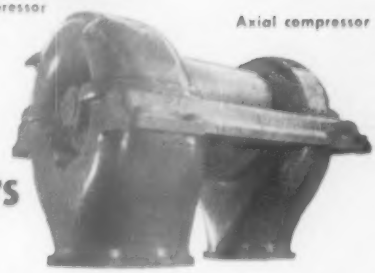


Two-stage sliding vane compressor

Any Volume Any Pressure



Single-stage centrifugal compressor



Axial compressor

Solve every process air or gas need from the most complete line of compressors

Whether you need main blowers, regenerator air, lift air, recycling, or vacuum pumps, Allis-Chalmers builds a type and size unit for the job.

Compressors that have run over two years without stopping have established Allis-Chalmers reputation for reliability in the petroleum industry.

One reason for such performance records is the smooth operation of Allis-Chalmers compressors . . . proof of careful engineering and manufacture. In addition, casings are rugged cast iron or steel, bearings are ample size and easily accessible for inspection and maintenance.

You need uninterrupted service and you get it with Allis-Chalmers compressors.

If motor-driven units are specified, Allis-Chalmers can furnish motors specially designed for petroleum industry applications, together with coordinated control.

CHECK HERE FOR INFORMATION

- ☐ Single-stage sliding vane compressors
- ☐ Two-stage sliding vane compressors
- ☐ Single-stage centrifugal compressors
- ☐ Multi-stage centrifugal compressors
- ☐ Axial compressors

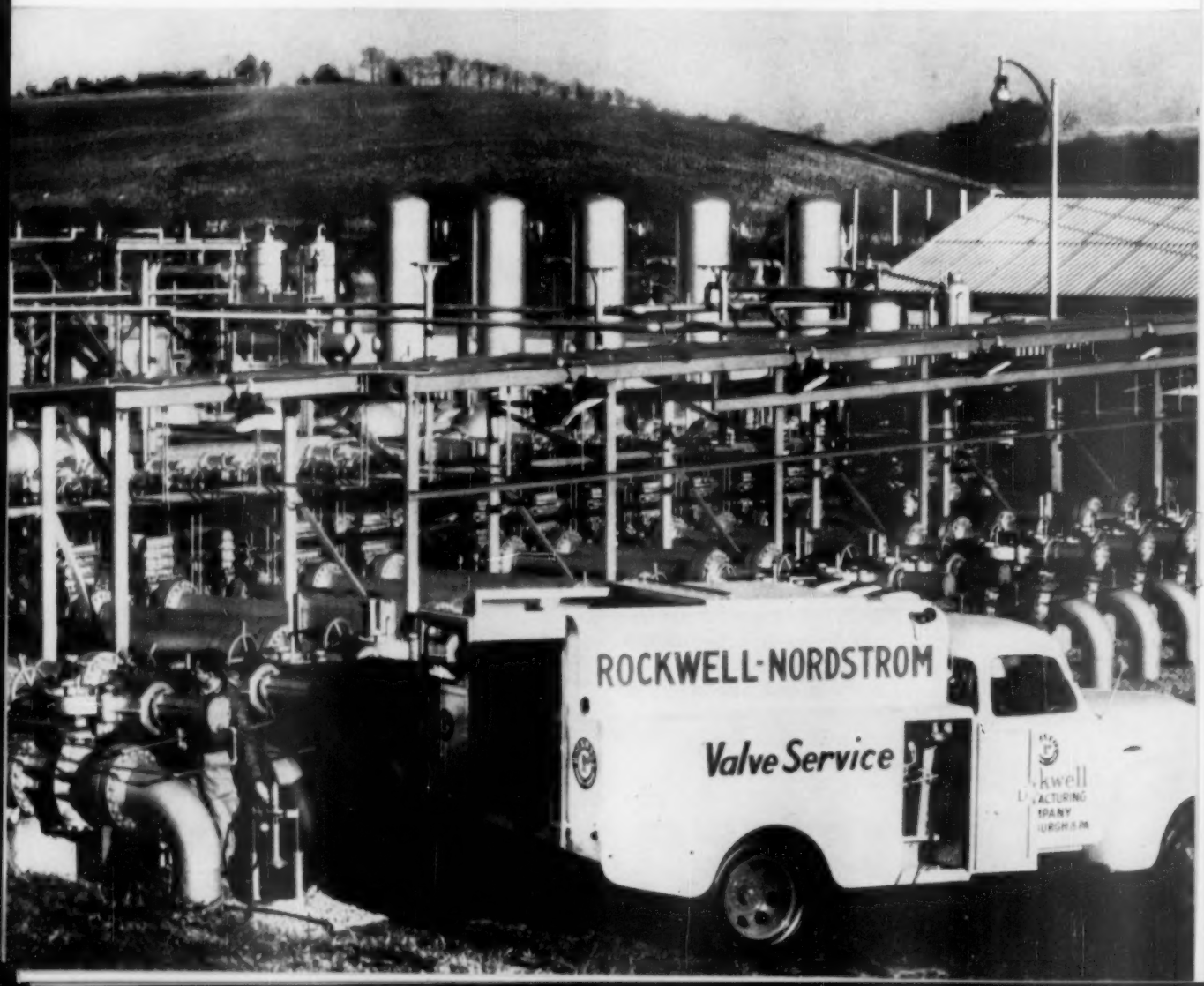
Add name and address in margin and send to your nearby A-C office or Allis-Chalmers, Milwaukee 1, Wis.

ALLIS-CHALMERS A-C

A-4751

NEW! Rockwell

A Mobile Service
For Low Cost
Contracted Valve Maintenance



"Workshops on Wheels"

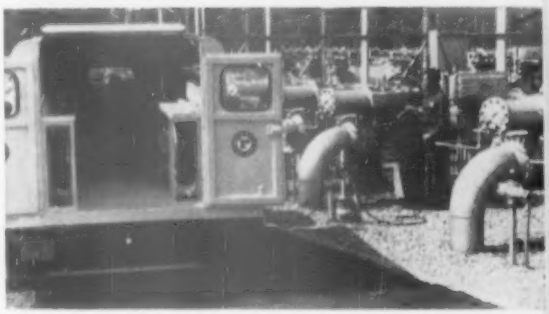
WHAT IT IS: Rockwell's new Mobile Maintenance and Lubrication Service is designed to increase the efficiency and lower the cost of valve maintenance for oil and gas field installations, refineries, pipe lines, chemical plants, and processing plants. It is made possible by a fleet of specially-built valve "workshops on wheels," manned by factory-trained experts, and equipped to provide complete "on the spot" service on a regular schedule, tailored to fit individual needs.

HOW IT WORKS: A Rockwell engineer, thoroughly familiar with Nordstrom valve design and maintenance, as well as with your particular process requirements, studies your installation in terms of its service needs. Then a mutually agreeable schedule is established for the servicing of your valves. From that time on, you have no valve maintenance worries; they become the responsibility of a Rockwell service expert. At regular intervals he will handle all servicing and lubrication quickly, efficiently, working from one of Rockwell's "workshops on wheels." These Rockwell-designed trucks are equipped with the most advanced lubrication, servicing and repair equipment, and built to operate with complete safety under any fire or explosion control requirements.

WHAT IT COSTS: Naturally, the price of this new planned maintenance and lubrication service varies with the size and number of valves, and with frequency of service. Definite prices are established after a Rockwell engineer has studied your individual requirements.

Actually, this new Rockwell service saves far more than it costs. It saves on fixed maintenance overhead. It saves on valve repairs. It saves by reducing costly down time. Because it is expert *preventive* maintenance performed on a regular schedule, it saves by spotting potentially expensive trouble *before* it gets expensive. And, of course, it saves on valve replacement costs because your valves will give you longer, more economical service life.

Pre-planned "on-the-spot" lubrication and service . . .



. . . performed by scientifically equipped experts . . .

. . . cuts maintenance, down time, and replacement costs.

The new Rockwell Mobile Maintenance and Lubrication Service is another extra value you can get only from the world's oldest and largest maker of lubricated plug valves. Its sole purpose is to help you get the best possible valve service at the lowest possible cost. For more detailed information, send the coupon below.

ROCKWELL-
Nordstrom **VALVES**

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

Rockwell Manufacturing Company
400 N. Lexington Avenue
Pittsburgh 8, Pennsylvania

☐ Please send me complete information about Rockwell's new Mobile Service.
☐ Please have a Service Engineer survey my valve maintenance needs.

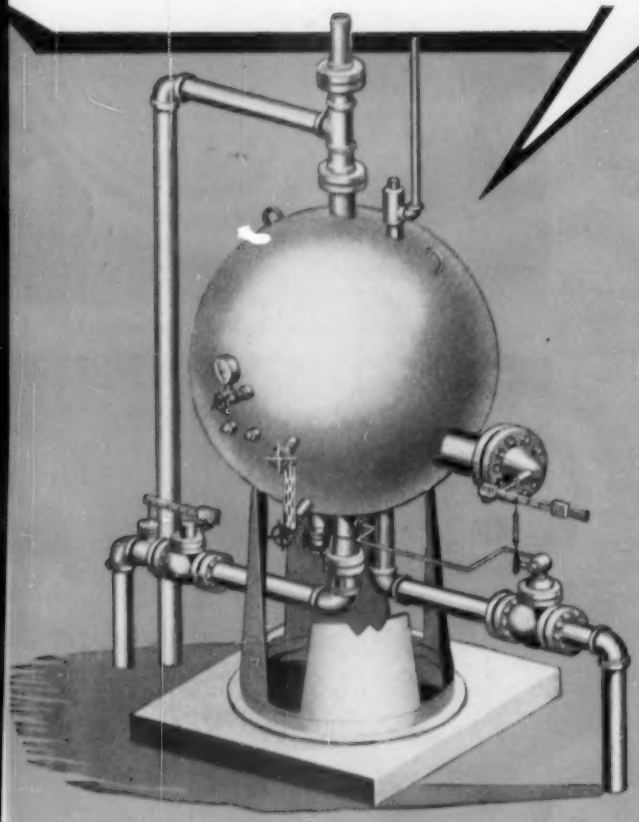
Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

Introducing The New BS&B Oil-Gas Spherical Separator



It's The Model "OGS" With *Exclusive* Internal Design!

BS&B's exclusive new Spherical Separator design takes full advantage of the spherical characteristics of the separator to provide maximum separation efficiency.

The inlet stream enters the top of the separator and passes through *three* separating stages as it flows downward through the vessel. Liquid is collected in the lower hemispherical head and is discharged by a liquid level controller through an outlet in the bottom of the vessel. Gas is also discharged out the bottom of the separator through a separate gas outlet pipe.

Type 30-26 (Low Pressure)

WP: 125 and 230 psi.
Shell Diameters: 40", 41", 46", 54".

Type 30-27 (Intermediate Pressure)

WP: 600 psi.
Shell Diameters: 24", 36", 42".

Type 30-28 (High Pressure)

WP: 1200 and 2000 psi.
Shell Diameters: 24", 36", 42".

FEATURES

1. **Simple Hookup**
   Connections to top inlet and bottom outlets are easily made from any direction.
2. **Liquid Slugs**
   Internal design diverts liquid slugs rapidly to the liquid section.
3. **High Capacity**
   The large ratio of liquid surface area to volume in the liquid section allows rapid release of solution gas from the oil.
4. **Controls**
   All controls and valves are BS&B.
5. **Small Space Requirement**
   Compact design is a distinct advantage of the Model "OGS" over other separators.
6. **Servicing**
   Convenient access openings are provided to simplify periodic cleaning and blow-down.

For Full Details on the BS&B Model "OGS" Spherical Separator, Contact Your BS&B Representative, or Write to . . .

BLACK, SIVALLS & BRYSON, INC.
Oil & Gas Equipment Division, Dept. 1-A108
1708 West Main Street • Oklahoma City, Oklahoma

EFFICIENCY · OVER 60 YEARS · BS&B · RELIABILITY · ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

FOR MORE INFORMATION AT THE BOTTOM OF YOUR WELL

Double Shut-In Pressure Readings Provide More Information — In Less Time — Than Other Methods

"WHAT IS THE main advantage of double shut-in pressure readings?" That's a question often asked by those who have not yet tried this newest method of drill stem testing.

Actually there are *four* main advantages of the double shut-in pressure method:

1. Maximum formation pressure build-up in shortest time.
2. Comparison of reservoir build-up pressures before and after test.
3. Two separate chances to obtain reservoir pressure.
4. The measuring of the true equilibrium pressure prior to producing the formation provides a virgin pressure measurement and more accurate data.

Perfected by Johnston Testers, this new technique requires only a simple rearrangement of the test tool assembly. By placing a disc valve above the main or hydraulic valve, a specified volume of air is trapped between these two valves. This volume of air is called the "air chamber."

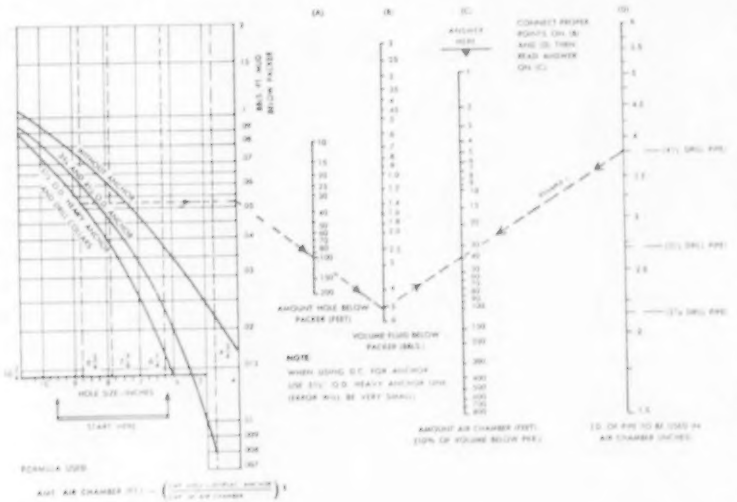
As the purpose of the air chamber is to relieve the mud pressure trapped below the packer, the secret of success of double shut-in testing is accurate use of this air chamber. Best results have been obtained when volume of the air chamber is about 10% of the volume of mud below the packer.

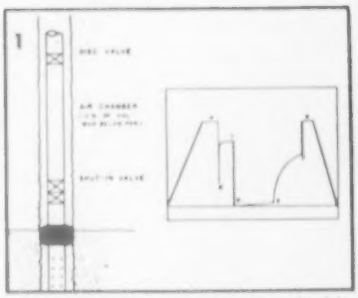
In the past, it has been common to calculate the air chamber to the nearest 30-foot pipe length. This lack of accuracy has often caused a failure to record the *maximum* initial shut-in pressure.

To overcome this problem, and to do away with complicated mathematics, Johnston has developed an "air chamber alignment chart." By simply drawing straight lines between known figures, the amount of air chamber needed can be calculated quickly and accurately.

The chart below shows how simple it actually is to use this method.

Complete information on double shut-in testing is available from Johnston Testers, Houston, Texas. Write today for complete descriptive folder.





Testing tool assembly for double shut-in pressure readings which permits a limited fluid withdrawal. By placing the disc valve above the main or hydraulic valve so that a specified volume of air is trapped between these two valves.

Well not capable of producing fluid fast enough to fill up air chamber and cause pressure build-up.

Mud did not expand enough to get pressure draw-down below the formation pressure.

Mud expanded and pressure draw-down was below the formation pressure. Well was able to flow enough fluid to fill up air chamber and build-up shut-in pressure.

JOHNSTON TESTERS

first in drill stem testing

HOUSTON, TEXAS

LOS ANGELES, CALIF. • CALGARY, CAN.

DSS51

FORMATION AND CASING TESTING — JOHNSTON

HOW TO BUY ROTARY HOSE THAT LOWERS DRILLING COSTS

. . . gives you "More Use per Dollar"

Look for a rotary hose construction with engineered features that assure safe, easy handling . . . a strong, flexible hose with a streamlined coupling that protects you against costly leaks and blowouts on the job.

A hose that is strong, flexible and correctly balanced, without being bulky, holds steadier in the derrick — even under the high pressure of deep drilling. If the hose is also light in weight it is easier to make-up on the rig . . . easier and *safer* to transport from hole to hole without damage or accident. Insist on a hose with strength members properly engineered and positioned to assure maximum flexibility . . . to resist kinking that can cause internal weakness and eventual hose failures. Insist, also, on a hose coupling that is streamlined with no protruding lugs or collars to interfere with easy handling, a coupling specially engineered to guard against leaks and blowouts . . . to add to the long, trouble-free life of the hose and reduce rotary drilling costs.

Specify, by name, the rotary hose engineered to give you dependable service under all drilling conditions . . . specify "Ray-Man" CBL Rotary Hose.

RAY-MAN CBL ROTARY HOSE

Special high-tensile steel cable wire reinforcement, precision wound under tension, gives Ray-Man CBL Rotary Hose a degree of flexibility—and safety—never before equalled. With strong, flexible strength members, Ray-Man offers maximum resistance to accidental crushing. This flexibility adds to safety and long life . . . makes Ray-Man easier to transport and rig-up without accident. Manhattan's streamlined, built-in coupling features the blow-out proof "Lip-Lok" seal that tightens under pressure. It is designed without protruding lugs or flanges — nothing to cause fouling or damage. These features of Ray-Man CBL Rotary Hose add up to the highest safety factor, longest life and lowest cost per foot drilled for your drilling operations..."More Use per Dollar." Write for Bulletin #6743.

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

Ideco *Full View Mast*

. . . You get *everything*!

Revolutionary design. 133' to 143'. Hook-loads (API) from 400,000 to 650,000 pounds.

A rigid free-standing structure, ample floor space, a full view of everything — all the advantages of a standard drilling derrick.

Moves and rigs up readily and economically on land or sea, as a good mast should. Drilling rig of any type or size can be used.

Ample room for an independent rotary drive. Wellhead equipment easily installed, and readily cleared when skidding.

Everything about this IDECO Full View Mast is designed to save time and money — the raising mechanism, racking platform, crown block, ladders, deadline anchor, substructure — even the rathole position.

It is made especially for the man who wants to be proud of his equipment, and expects the equipment to justify his confidence. You get *everything* in an IDECO Full View Mast.

Read the details and study the diagrams in Bulletin FVM-53. Address JONES & LAUGHLIN SUPPLY DIVISION, P. O. Drawer 2481, Tulsa, Oklahoma, or 'phone your J&L store.

Jones & Laughlin

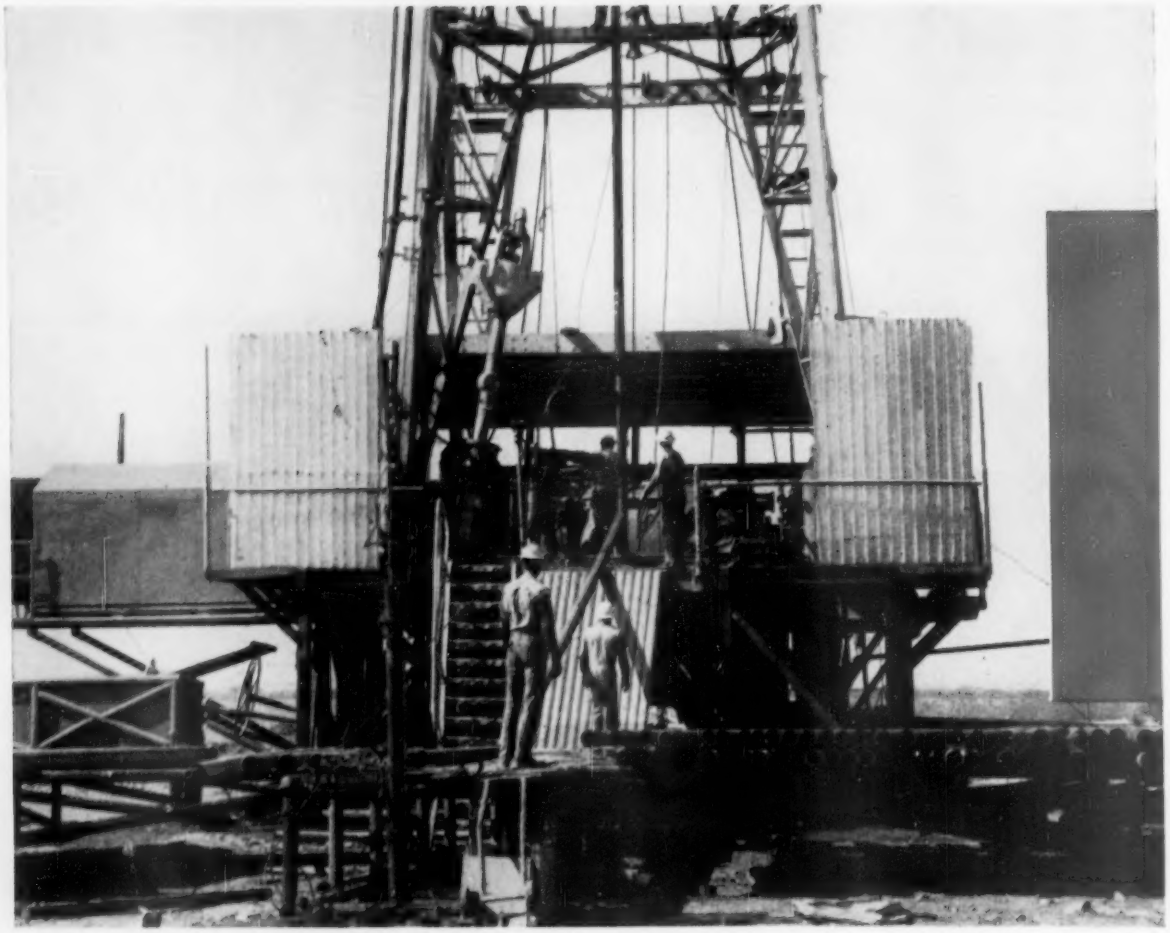
STEEL CORPORATION

SUPPLY DIVISION – Tulsa

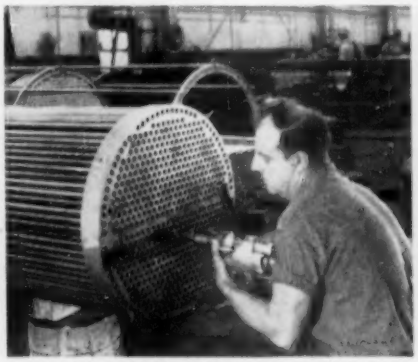
SERVING THE UNITED STATES AND CANADA

J&L STEEL

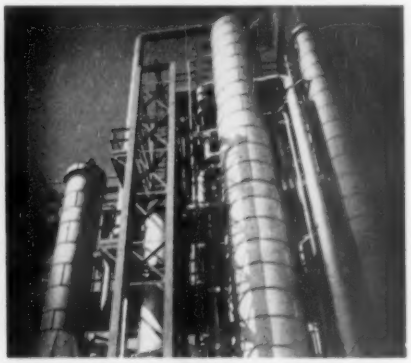
130-M



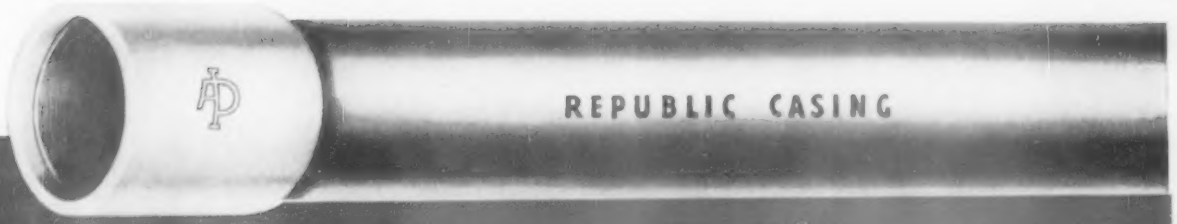
PIPELINERS CAN BUY THREE KINDS OF LINE PIPE FROM REPUBLIC. Big-diameter Electric Fusion Weld (24" through 30") is a favorite throughout the industry for high pressure gas and oil transmission jobs. It comes in straight lengths, bends easily, welds rapidly due to constant circumference. Electric Resistance Weld (2⅜" through 16" O.D.) is equally dependable, easy to install, longlasting. And its high ductility assures smooth, uniform bends. Continuous Butt Weld is an old standby in the industry for gathering and distribution lines. From ⅛" through 4" nominal. Send coupon for facts.



GET MORE PRODUCTION WITH LESS DOWN TIME by installing dependable carbon steel ELECTRUNITE Heat Exchanger and Condenser Tubes made by Republic's Steel and Tubes Division. For more than 25 years, oil processors have found it pays to rely on Republic's high standards of quality control. Full normalizing of every length results in uniform ductility. Rigid manipulation tests, as well as non-destructive electric or hydrostatic testing, assure users of unsurpassed quality. Made to customer, A.S.T.M. A-214, or other applicable heat exchanger specifications. Send coupon for details.



CORROSION IS NO PROBLEM IN THIS RECOVERY PROCESS INSTALLATION. That's because the liners and headers are made of 18-8 stainless steel. Tough, strong, and durable, stainless steel resists the corrosive elements present in oil refining. And its smooth, hard surface is easy to clean. Protect your investment with equipment made of the finest stainless. One of the most widely used among fabricators today is Republic ENDURO Stainless Steel. Let Republic put you in touch with refinery suppliers who make the equipment you need.



Your Republic Oil Country Distributor Sells Both...

REPUBLIC ELECTRIC WELD AND SEAMLESS CASING AND TUBING

Here's an opportunity to centralize your buying of these products—and at the same time guarantee uniform quality throughout every string.

Recognized throughout the industry for its dependability, Republic Normalized Electric Weld Casing and Tubing have been a favorite with oil producers in every field for more than 25 years.

Drillers like the important advantages which result from Republic's electric resistance welding process. Full-formed threads and uniform roundness that make for fast stabbing, spinning and tonging—strong, tight joints that resist pullouts. High resistance to collapse is assured by high ductility, uniformly high-yield strength and uniform roundness of the product. Available in grades H-40 and J-55, Electric Weld comes in sizes 2⅜" through 13⅜" O.D.

Republic Seamless Casing and Tubing, newest in the line, are also well endowed with Republic quality. Produced in the world's most modern seamless mill, by the latest precision equipment and techniques, seamless quality is carefully guarded from ore to finished product, to provide drillers with maximum in-the-hole protection. Made in grades J-55 and N-80, Republic Seamless ranges in size from 2⅜" through 9⅝" O.D.

The next time you contact your Republic Distributor take advantage of Republic's integrated facilities and order both Electric Weld and Seamless. For more complete information call your nearest Republic sales office. Send coupon for illustrated literature.

REPUBLIC STEEL

World's Widest Range

of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
3112 East 45th Street
Cleveland 27, Ohio

Please send me complete literature on:

- ☐ Casing and Tubing
- ☐ Enduro Stainless Steel
- ☐ Line Pipe
- ☐ Heat Exchanger Tubes

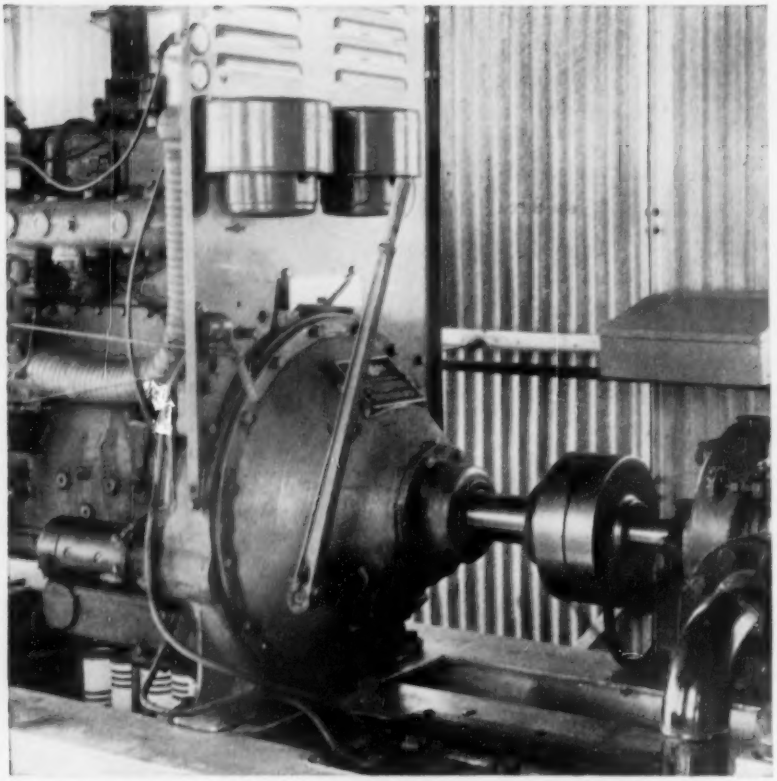
Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

K-8301



Twin Disc Friction Power Take-Offs are provided in single-plate 6.5" to 24"; double-plate 11.5" to 24"; triple-plate 14" and 18". Housing sizes No. 6 SAE to No. 00 SAE. Capacities to 650 hp. Typical installation shown is on a Waukesha gas engine. **Request Bulletin 129-C.**

Known by the power it applies

To both the engine manufacturer and user, the power take-off—connecting driving and driven equipment—is one of the most critical components in the driven line. Here is the vital link where all horsepower and torque must be transmitted before any work is accomplished . . . a link which can become a costly "Achilles" heel through failure on the job.

In specializing exclusively since 1918 in the design, manufacture and application of industrial drives for powered equipment, Twin Disc has developed Friction Power Take-Offs that assure trouble-free operation throughout the working life of machines to which they are applied. Designed for superior performance, they are backed for their lifetime with unparalleled service.

That's why the Twin Disc Power Take-Off is known by the power it applies. Throughout industry, you see them behind engines built by the world's leading manufacturers . . . for both manufacturers and users know *this* Power Take-Off will never become an "Achilles" heel on the job, to either operation costs or production schedules.

TWIN DISC

TWIN DISC

Friction Clutches and Fluid Drives

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • HYDRAULIC DIVISION, Rockford, Illinois

Branches or Sales Engineering Offices: Cleveland • Dallas • Detroit • Los Angeles • Newark • New Orleans • Seattle • Tulsa

AJAX

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MURPHY DIESEL

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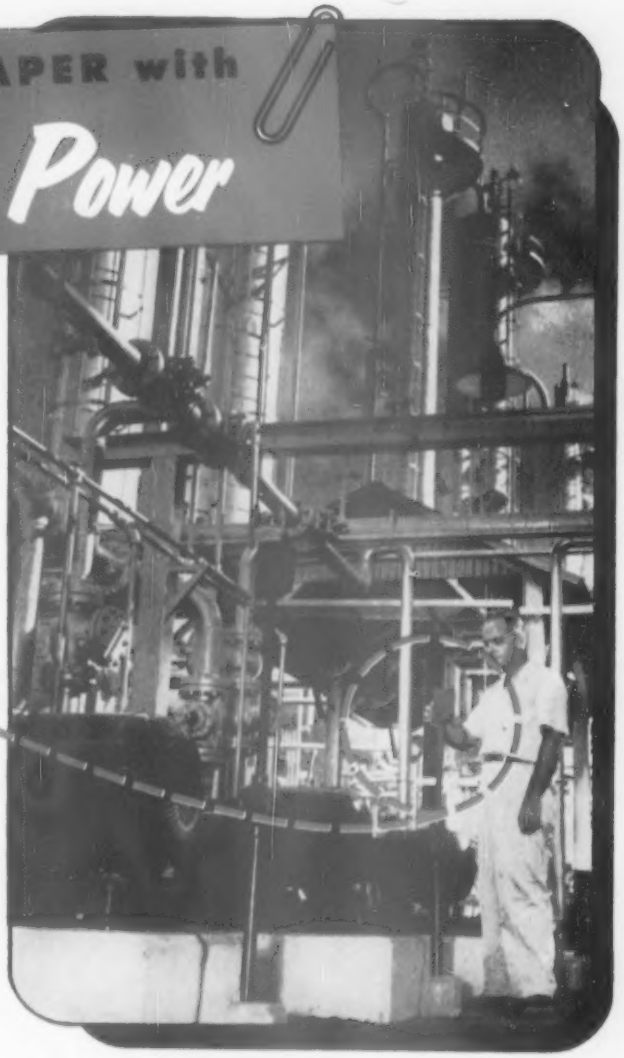
Waukesha Motor

WISCONSIN ENGINES

WITTE

All trade marks shown above are Reg. U. S. Pat. Off.

You can do it CHEAPER with UTILITY *Electric Power*

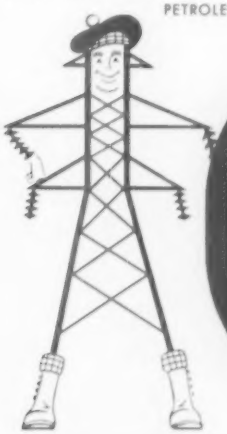


Low Cost Power!

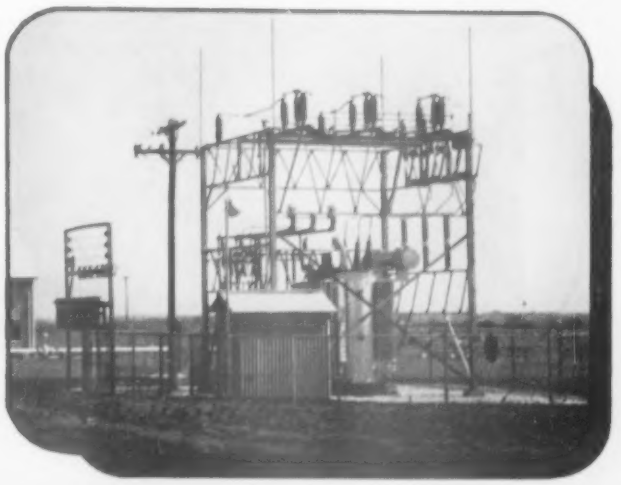
Utility Electric Power gives you just that . . . PLUS MORE! Wherever oil is lifted, moved, or refined, Utility Electric Power will do a great job! Low initial cost . . . low maintenance and operating costs . . . complete dependability around the clock . . . safety, convenience and automatic control to meet your power requirements. Yes, these advantages are yours when **Economical** Utility Electric Power is specified.

Petroleum Electric Power Association

P. O. BOX 2771, DALLAS, TEXAS
ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY



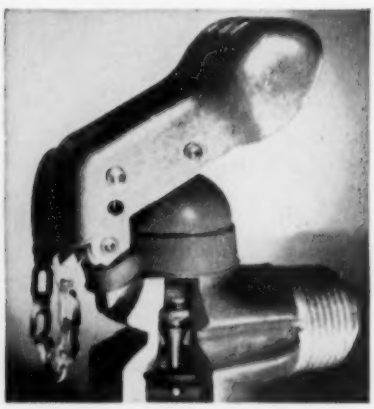
CALL YOUR LOCAL ELECTRIC SERVICE COMPANY for POWER FACTS



Here's why Ansul extinguishers give you faster, more dependable fire protection!

READY for instant action under the most severe exposure conditions.

WEATHER-TIGHT NOZZLES made of aluminum and stainless steel, can't rust. Neoprene cap and oil-impregnated washers keep out moisture.



PUNCTURE PIN. In this aluminum housing a stainless steel pin pierces the gas cylinder that supplies the propellent power for the dry chemical.

PATENTED NOZZLES. Straight or fan stream, the hazard determines which is installed. An Ansul exclusive for more effective fire control.

FIELD RECHARGING. Just 4 minutes after a fire is extinguished your Ansul unit can be recharged, ready for action. No special tools are needed.

The pictures on this page tell half a story. The complete story includes Ansul's facilities for training your personnel in the science of fire control and prevention. Experience has taught us that *complete* fire protection demands *both*—fast, dependable equipment and trained personnel to man that equipment. Ansul can provide both. Get in touch with your local Ansul man, he has the complete story about *complete* fire protection.

Call the ANSUL MAN!

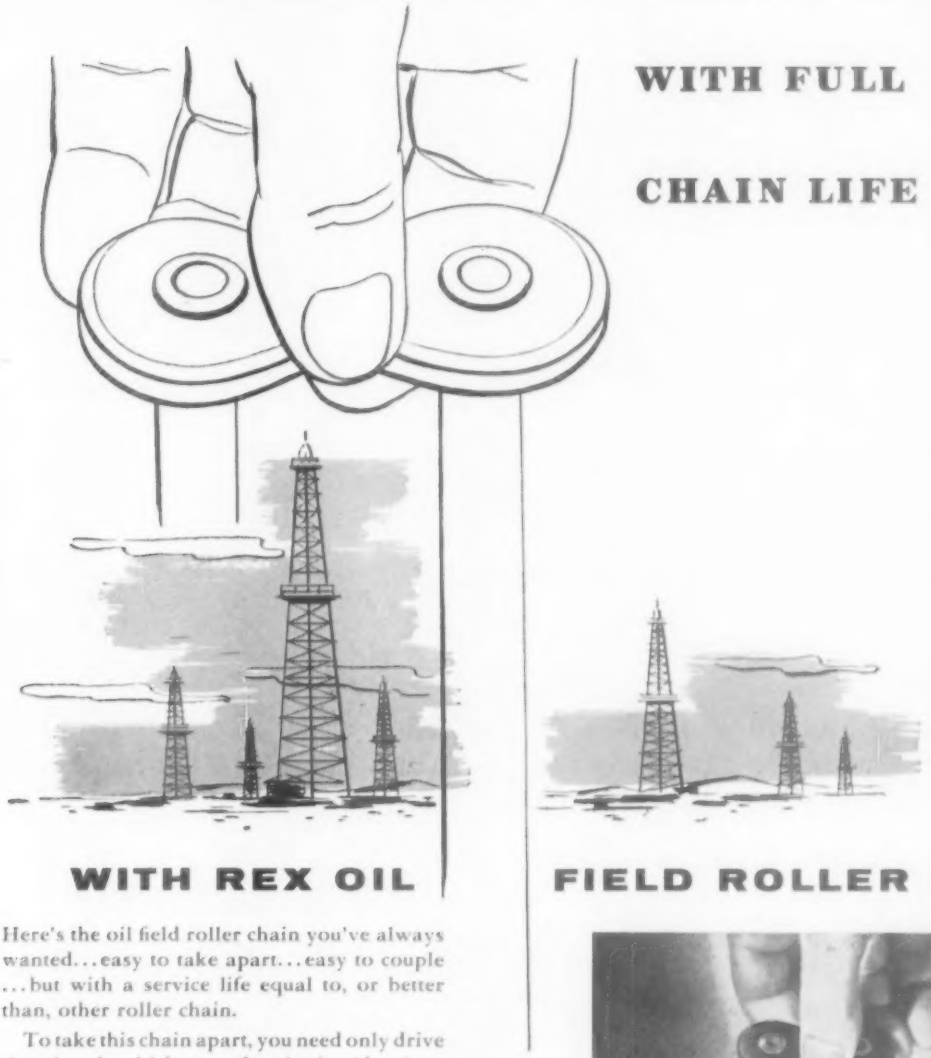
Get in touch with your local Ansul man through the "yellow pages," or write direct to ANSUL CHEMICAL COMPANY, Fire Equipment Division, Dept. F-91, Marinette, Wisconsin.

Write Ansul for your copy of New Fire Equipment Catalog.

ANSUL

NOW YOU CAN HAVE...

EASY COUPLING–EASY UNCOUPLING



WITH FULL

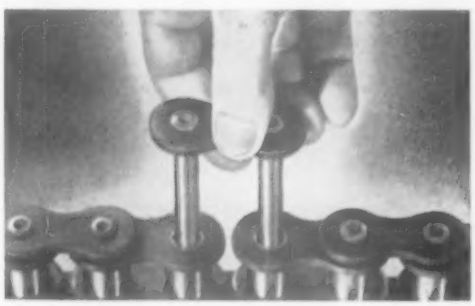
CHAIN LIFE

WITH REX OIL FIELD ROLLER CHAINS

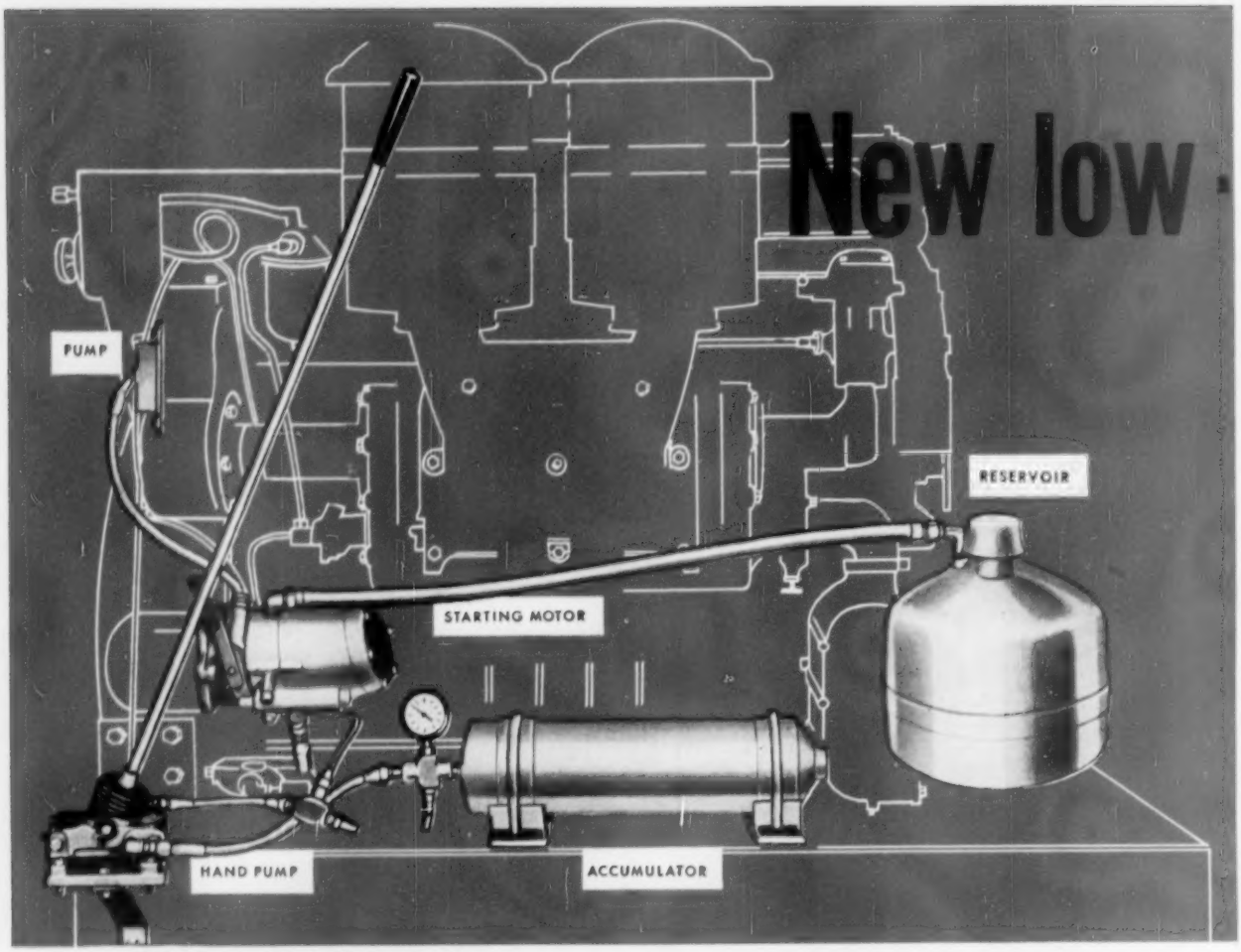
Here's the oil field roller chain you've always wanted...easy to take apart...easy to couple ...but with a service life equal to, or better than, other roller chain.

To take this chain apart, you need only drive the pins the thickness of a single side plate. Then, you can pull the pins the rest of the way through the chain by hand...or by light tapping. It's just as easy to couple together.

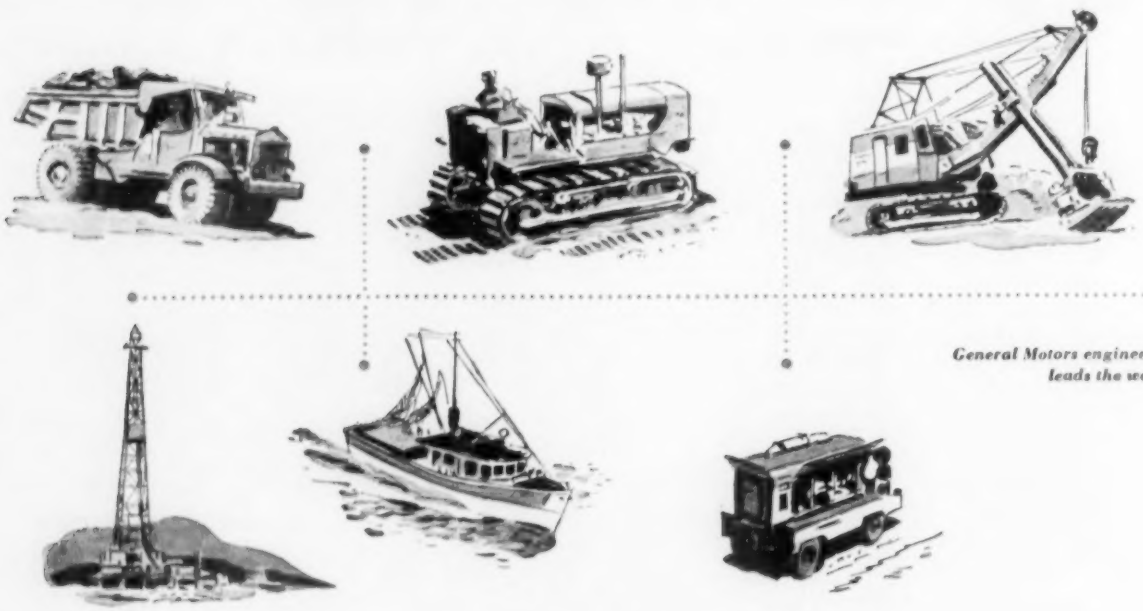
These desirable features are now possible without sacrificing the long-life features of heavy press fit chain. Investigate this chain for your needs, today. See your supply store or write for your copy of Bulletin No. 55-3. Chain Belt Company, 4619 W. Greenfield Avenue, Milwaukee 1, Wisconsin. Oil Field Offices: Dallas, Houston, Midland, Los Angeles, New York, Tulsa. Oil Field Warehouses: Dallas, Houston, Los Angeles.



CHAIN BELT COMPANY



NEW Aeroproducts Hydrostarter brings quick, sure, safe starting to Diesel engines in all kinds of weather. It frees Diesel operators from battery replacements, costs less than any other nonelectric Diesel starting system.



General Motors engineering leads the way

· cost Diesel Hydrostarter

For positive all-weather starting

Now you can start your Diesel engine quickly in any kind of weather with the new Aeroproducts Hydrostarter – the hydraulic starting system that replaces regular starters.

It spins a Diesel twice as fast as battery-operated starters, has no parts or components that require regular replacement, costs less to operate than electric starting systems.

It fits any Diesel engine up to 300 horsepower, lasts the life of the engine on which it is installed.

And it sells for a far lower price than any other nonelectric Diesel starter available today.

Easy to install—simple to maintain

Your Diesel engine dealer or equipment distributor can quickly install the Aeroproducts Hydrostarter on your Diesel. The system is so simple that his mechanics—or yours—can do the job with no special training. And all it takes is a few hours' time for installation.

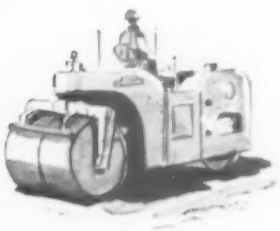
With a Hydrostarter on your Diesel your maintenance costs will drop, too. It's completely self-contained—routine maintenance checks are all the care it needs.

How the Hydrostarter works

Heart of the system is a hydraulic starting motor operated by high-pressure fluid. Pressure is built up and maintained by an engine-driven pump in a piston-type accumulator.

A simple control lever admits this high-pressure fluid to the starting motor, spinning the engine. This control lever also completely engages the starting motor's gears with the Diesel's flywheel before operation.

The hand-operated pump is provided to turn over the Diesel slowly for mechanical adjustments. It also is available to raise pressure if needed. The working fluid is stored and filtered in a reservoir.



See your dealer or write today

If you want quick, sure starts for your Diesels, ask your engine or equipment dealer about the new Aeroproducts Hydrostarter. He can give you full information—or quickly get it for you. If you prefer, fill in the coupon or write direct for more information.

GM GENERAL MOTORS

Building for today...Designing for tomorrow

Aeroproducts

ALLISON DIVISION OF GENERAL MOTORS
DAYTON, OHIO

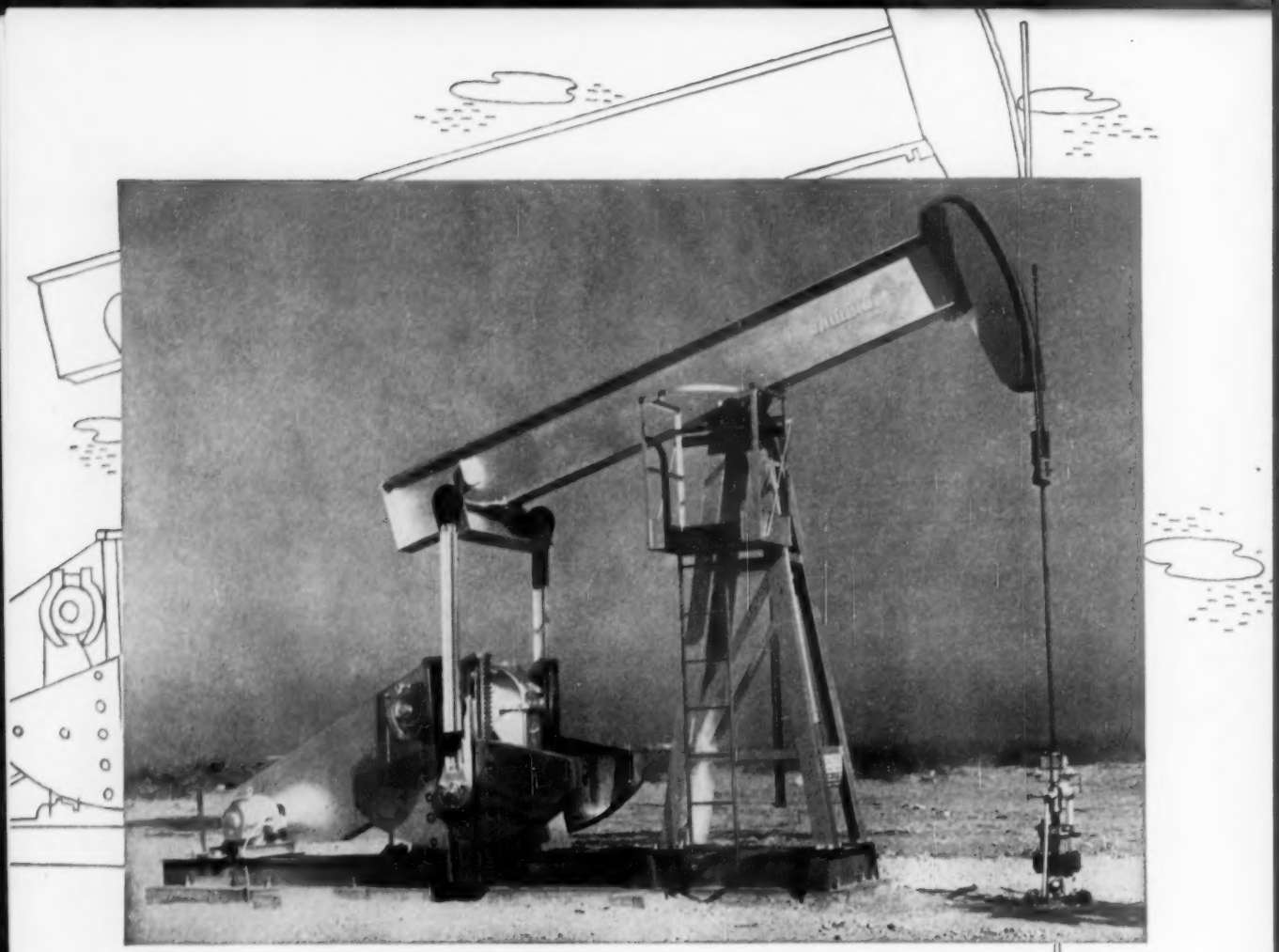
Please send me full information on the new Hydrostarter.

NAME_____

POSITION_____

COMPANY_____

ADDRESS_____



What an opportunity...
...for pumping Economy!

Parkersburg Pumpers combine Peak Performance with less maintenance, less servicing, less down time to bring lifting costs down to an irreducible minimum. Performance records in fields all over the world prove their unequalled efficiency and economy.

Designed and built to deliver this kind of service—and available in 56 sizes and types—you can take advantage of Parkersburg pumping economy, regardless of your well conditions. Ask your Parkersburg Representative to submit details and prices on Parkersburg Pumpers for your needs.

Parkersburg
RIG AND REEL COMPANY
DIVISION OF PARKERSBURG : AETNA CORPORATION

3345 WINTHROP AVENUE
FORT WORTH 16, TEXAS

5511

Kaiser Aluminum pipe and couplers save $219 per mile over steel!

A recent test conducted by Kaiser Aluminum in Texas provided cost comparisons on the installation of two drill rig supply lines—a 4-inch all-aluminum system vs. a 4-inch all-steel system.

The result—complete cost for laying one mile of steel pipe: $263.90. For aluminum: $44.07. Total savings with Kaiser Aluminum pipe and couplers: $219.83!

The reason—1) use of lightweight Kaiser Aluminum pipe (1/10 the weight of an equivalent steel pipe) speeded handling by 39½ man hours—a saving of $84! 2) newly-designed detachable couplers, developed by five different manufacturers in cooperation with Kaiser Aluminum, cut connecting and disconnecting time 61½ man hours—another big saving of $135!

Thus, the combination of light, strong Kaiser Aluminum pipe and the new quick-connecting couplers permit a faster, lower-cost installation than ever before possible!

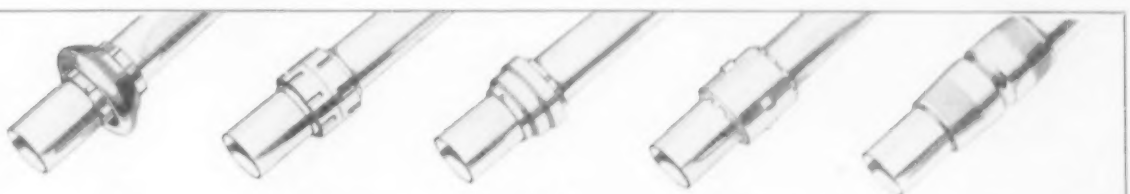
Get in on these big savings now! Your nearby supplier stocks Kaiser Aluminum petroleum pipe in 30-foot lengths of 2, 3 and 4 inch diameters. He also has the necessary couplers and fittings to complete your systems.

Kaiser Aluminum petroleum pipe is roll-formed and induction welded from high-strength aluminum alloy sheet. Design pressure is above 1500 psi, guaranteed test pressure 1000 psi, recommended operating pressure 500 psi, providing a nominal safety factor of 3 to 1. Inside surface is clad with high-purity aluminum to increase resistance to corrosion.

For further information, contact the Kaiser Aluminum sales office listed in your telephone directory or any of the fitting manufacturers listed below. Kaiser Aluminum and Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Ill.; *Executive Office*, Kaiser Bldg., Oakland 12, Calif.

Kaiser Aluminum

setting the pace—in growth, quality and service



Made by
Food Machinery & Chemical Corp.
John Bean Division
San Jose, California

Made by
Gateways Engineering Co.
3233 W. Grand Avenue
Chicago 51, Ill.

Made by
Industrial Coupler Co.
P.O. Box 1751, 4218 Boone Ave.
Spokane, Wash.

Made by
Warren Manufacturing Co.
11 Hamburg Turnpike
Riverdale, N. J.

Made by
Wright Engineering & Supply Co.
1300 S. Bannock St.
Denver 23, Colo.

THESE FIVE tested and approved fittings require no welding: manifolding may be accomplished in the field quickly and easily. Couplers form guaranteed leakproof connections at liquid and gas pressures of 0 to 1000 psi.

HOW TO get mud valve economy

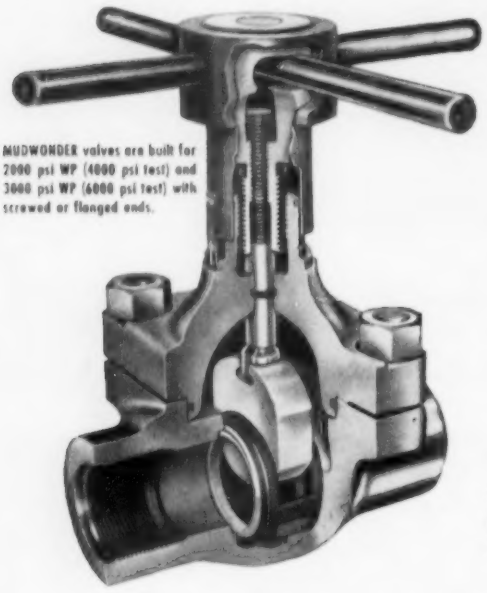
Switch to competitively-priced
Rockwell-Built **MUDWONDER**
Valves for ALL mudline services

Longer wearing parts which can be replaced easily and quickly are causing the big switch to MUDWONDER by cost-conscious drillers.

Whenever maintenance is needed, the operation is simple. Bonnet assembly lifts off without disturbing the mudline hook-up.

Inspection or part replacement, if necessary, can be made while the crew is making a connection. Extra seats and, perhaps, a gate for each size—both are interchangeable between pressure classes—are all the parts inventory you should need.

Replace troublesome mud valves today with MUDWONDER. Drilling men everywhere are switching to MUDWONDER. They've tried it—even abused it—to prove its economical superiority for installation, for operation, for maintenance.



MUDWONDER valves are built for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test) with screwed or flanged ends.

Here is the wear-absorbing heart of the MUDWONDER—
Hard-chromed gate in combination with buna-N seat molded integrally over steel wear rings resist abrasion.

On your rig you can expect the Rockwell-Built MUDWONDER to: SLASH DOWNTIME . . . ASSEMBLE EASILY . . . GIVE LONGER SERVICE . . . OPERATE EASIER, FASTER . . KEEP MUDLINES INTACT . . . STOP SANDING UP

Ask your favorite oil field supplier for more information or write to Edward for Catalog 12-S.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
1212 W. 145, EAST CHICAGO, INDIANA

Beacon • • • and Your Refinery

The marketing of petroleum products is complex. It requires a well coordinated team experienced in both domestic and industrial markets. At Beacon Petroleum Company you will find such a team. Specialists in every phase of petroleum marketing and transportation devoted to one thing . . . moving *your* products successfully to their proper markets.

If you want to successfully market *any* type of petroleum product — contact Beacon . . . or if you want to *buy* any petroleum products . . . contact Beacon.

BEACONGAS

BEACON

PETROLEUM COMPANY

TULSA • HOUSTON

MARKETERS OF NATURAL GASOLINE, BUTANE-PROPANE, MOTOR FUEL, FUEL OILS

Whether you're drilling with a multi-million dollar off-shore rig . . .

whether you're in production drilling . . .

Mr. Independent Is On Hand To Help You Push Footage Costs Down And Drilling Profits Up

With competition breathing hot on the back of his neck, the only way a drilling contractor can make wells pay under today's low contract footage prices is to drill faster and get more for his drilling dollar.

Throughout the oil industry, pressure is on to drill more holes per rig. Producers, engineers, purchasing agents, and drilling contractors alike are striving to improve drilling rates and lower the cost per-foot-of-hole.

Well-drilling techniques are improving as the science of drilling advances. More drillers are using big drill collars and high bit weights. Stabilizers and reamers, to prevent rapid buildup of hole angle, are being employed more widely. Better hydraulic systems and improved mud programming are contributing to drilling speed. Permanent-type completions are reducing drilling time.

But the best planned drilling program can be knocked off schedule by costly delays in equipment and supply service, particularly in emergencies. That's why more and more oilmen are taking advantage of the dependable, streamlined service offered by the independent distributor.

Because the independent distributor makes a specialty of serving a small area well, rather than thinning out his service over tremendous territories, his service is fast and flexible. He is friend, neighbor, and working partner to the oilmen he serves.

Knowing your problems, "Mr. Independent" is able to anticipate your requirements. He is on the spot to meet emergencies 24 hours a day, seven days a week, and can supply you with even the smallest items of equipment on short notice. Yet, because he is independent—free from inflexible company rules, remote control, and red tape—he can make big decisions quickly and fill large requirements without delay.

And you'll find another difference in his service: It's personal. He has lived close to your operations for many long years. You know him and he knows you, so you can do business with him conveniently and with less paperwork. This friendly relationship exists all the way up the line with an independent, from the field salesman and store manager to the top men who are continually on the move visiting their customers' operations and keeping in touch with their activities.

The extra service Mr. Independent offers comes at no extra cost. You can be sure his prices are right because he works on low overhead. He is used to competition because his livelihood depends on being able to meet it.

The efficiency of the small, fast-moving distributor's organization, and his long experience in the oil fields, give him an advantage. So when you figure the additional service he can offer you at prices that are competitive, you are ahead when it comes to holding down your cost per-foot-of-hole.

Individually, these distributors confine their services to limited areas but collectively, they cover every important drilling territory in the country and some outside.

Glance down the list of 19 distributors (at right) who handle Pittsburgh Seamless Oil Country Goods, for example. They have a total of 141 stores ready to take care of your equipment and supply problems. So they are available wherever you are.

How about quality? The independent distributor is able to

or wildcatting with a portable rig . . .

select the products he carries from the best equipment manufacturers. He chooses the range and variety he knows are best suited to your requirements.

This means the independent is backed by reputable manufacturers with long experience and know-how in making the equipment you use. The distributors listed at right carry Pittsburgh Seamless because they know Pittsburgh Steel Company has been producing it for more than 50 years and has established a reputation for doing a good job.

Newly modernized and expanded mills have equipped Pittsburgh Steel to make better seamless for you today than ever before. While it has no financial interest in any distributor, it gives them the kind of quality and technical assistance they can count on for reliable service to their customers.

The next time you need a string of drill pipe, casing or tubing, why not get the pipe of your choice through the supplier of your choice? Specify Pittsburgh Seamless!

For Fast, Personal Service

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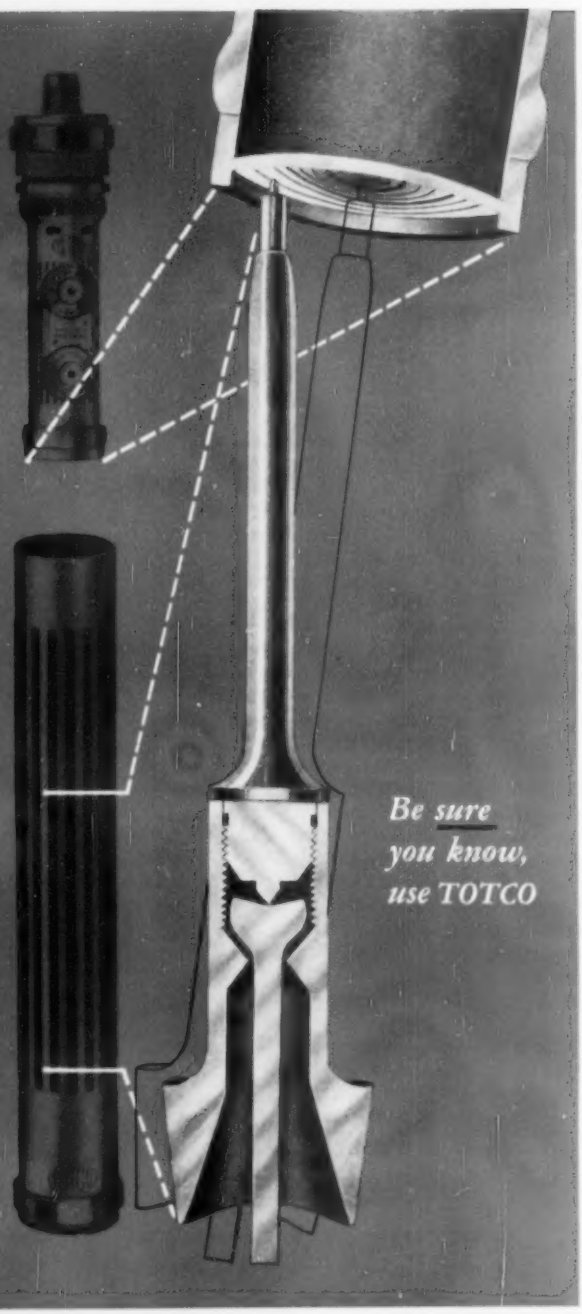

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They Say—

Keeping the Record Straight

"Adlai E. Stevenson was wrong on nearly all counts in what he had to say about the tidelands during his Texas visit last week. And Senator Price Daniel of Texas was only a little less so.

"The tidelands issue was the cause of the 1952 break between Mr. Stevenson and Governor Shivers, and was a major reason Texas was in the Eisenhower column in the presidential election of that year. Mr. Stevenson now says he was for a compromise solution of the issue, and that Texas would have profited financially if it had taken his advice rather than Governor Shivers'.

"The trouble with Mr. Stevenson's talk of a compromise solution is that, at the time he was running for the presidency, Texas had nothing left to compromise. By decision of the U.S. Supreme Court in 1950, it had been deprived of all right or title to the offshore lands it had owned before coming into the Union and which the agreement of annexation had included within its boundaries. The decision left Texas with nothing to trade. By this ruling, the federal Government owned it all.

"Outraged at what they considered an out-and-out seizure of land they owned, Texans were bent on getting the offshore lands back, and they were intensely interested in the attitude of the presidential candidates on the question.

"Mr. Stevenson, in a statement issued after Governor Shivers had flown to Illinois to interview him on the subject, said he would do nothing to undo the Supreme Court decision. He did say he favored enactment of legislation 'providing equitable arrangements for the administration of these lands and the disposition of their proceeds.'

"This was highly vague, since it did not spell out Mr. Stevenson's idea of an 'equitable arrangement' or make it clear whether he was talking about dividing the tidelands proceeds among all the states or only with the states from which they had been taken. Texans . . . were in no mood for vagueness. They wanted assurance of positive support for return of their divested property.

"Presidential Candidate Stevenson declined to give that assurance. Candidate Eisenhower did, in these unequivocal words: 'I favor the recognition of clear legal title to these lands in each of the 48 states.' The most

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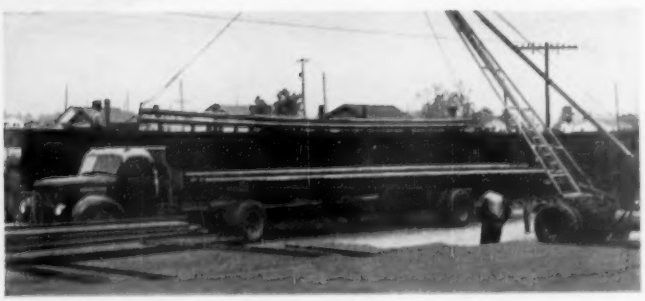

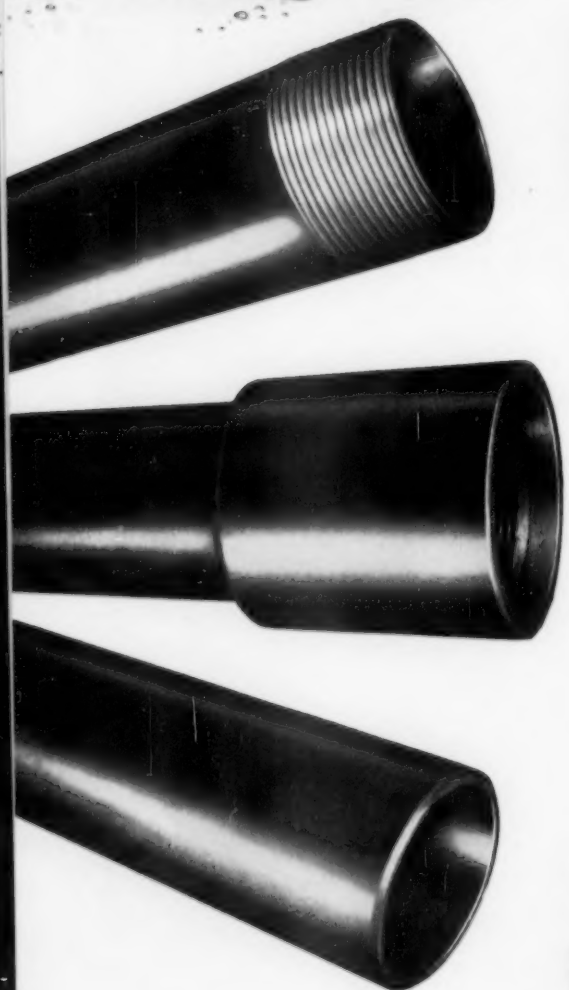

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Beth-Co-Weld can be furnished in accordance with the requirements of ASTM-A-120 and A-53, API 5L and other equivalent specifications. It is sold on a competitive basis. It can be obtained coated, or uncoated for field wrapping. In addition, it can be wrapped at the mill. You can get prompt delivery, too, regardless of quantity.

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Beth-Co-Weld comes in sizes from ½ in. nominal to 4½ in. OD in both black and galvanized in standard weight, and in sizes ½ in. through 3 in. nominal in extra-strong weights. Supplied in weights lighter than standard in sizes 3½ in. OD and 4½ in. OD. Available in single mill lengths, also in sizes 1½ in. through 4½ in. OD in double mill lengths up to 50 ft, and can be furnished threaded and coupled, plain end beveled for welding, or plain end square cut grooved for ring joint coupling.

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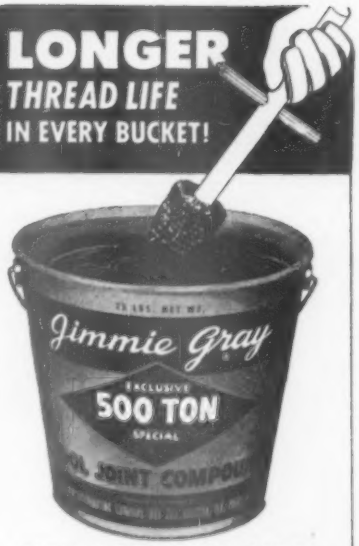

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Mr. Stevenson ever said was that possibly the issue might be settled by allocating 37½ per cent of oil royalty from the tidelands to the states in which they were located—but he was by no means certain this was the correct formula."

Editorial, Fort Worth Star-Telegram.

Atom to Shift Industry

" . . . It has been the general industrial procedure to carry raw materials to the site of the fuel since transportation costs for fuel were higher than for the raw materials to be fabricated with the energy available from the fuel . . .

"This situation is reversed with respect to atomic power. Now one ton of uranium can be transported cheaply —this ton is equivalent to a million tons of coal. The transportation factors are now to be multiplied or divided by a factor of a million, in other words.

"Quite a relocation of American industry may well result from this fact alone."

Dr. Robert T. Nieset, Tulane University, in address before Louisiana-Arkansas division Mid-Continent Oil and Gas Association, New Orleans.

Oops! An Error

Dear Sir:

This refers to the article entitled "More Independents Are Going Abroad" written . . . in The Oil and Gas Journal (May 30, page 46). In his adjacent picture the writer erroneously assigned No. 17, the McCarthy concession, to the Republic of Paraguay, when in reality it is found in the Bolivian area.

Let us note that in the same magazine, within the informative international notes, the workings of the McCarthy company in Bolivia have already been mentioned, in the issue of November 30, 1953, page 51; issue of December 27, 1954, page 56; and there also was reference made to the declaration of President Pas Estenssoro concerning a more attractive oil legislation in the issue of March 28, 1955.

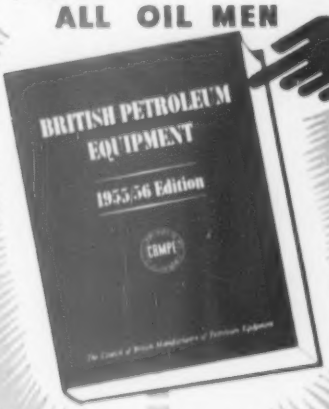
These preceding matters are sufficient that we believe the error is the fault of the one who made the map.

Eduardo Hinojosa Acha, general manager of Yacimientos Petroliferos Fiscales Bolivianos.

New Drilling Frontier

"If there are deeper possibilities (for oil in western Pennsylvania) why hasn't someone drilled for them? One reason why an 'outsider' would not drill deep test wells is because the lease situation

Attention!
ALL OIL MEN



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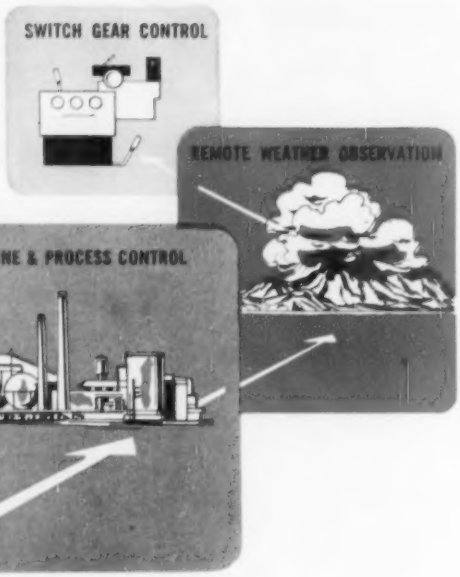

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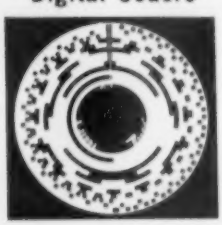

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in this area is in such shape that an outside operator would spend too much time and money to get together a large enough block to justify the expenditure.

"Fortunately for you people, the place best suited for deeper drilling coincides very closely with the area that already has shallow production on it. Unfortunately for the outsider, if the property has been abandoned, many times it's impossible to get a new lease on it inasmuch as the royalty owners are too numerous and too scattered all over the country.

"Also, a lot of the acreage is already under lease. So, from the outsider's viewpoint, the area is not favorable, acreagewise. Obviously, you can't drill a well without a lease. I do not know why you operators yourselves have not drilled some deep wells."

Earl H. Linn, chief geologist for Benedum-Trees Oil Co., in address before Middle District Producers Association at Butler, Pa.

Competition for Brains

"As our business becomes more technical, we are in competition with other industries for technical personnel, and there is a dearth of that kind of manpower.

"It seems to me that the capturing of your students' imaginations and the awakening of their interest in the things you teach and the encouragement to pursue scientific learning is your obligation—not only to the students themselves but to us who may become their future employers."

Christy Payne, Jr., vice president of Peoples Natural Gas Co., in address before western Pennsylvania science teachers.

Canadian Gas Important

"I would like to say from the standpoint of the El Paso Co. We have always regarded, and we still regard a connection into the present reserves and the potential reserves of Canada as being a matter of high importance to the El Paso Co., and we have never given up.

"If you have got to supply 2.5 billion feet of gas a day . . . then any potential reserve that is within reach is important, and we have studied Canada enough to know it.

"We have studied the Rocky Mountain region well enough to say that it is—I wouldn't say giving out, but that difficulties are increasing, and the cost of finding it is increasing, but more than anything else, the actual difficulty of finding it at all, and that is serious."

Paul Kayser, president El Paso Natural Gas Co., in testimony before Federal Power Commission.

CALENDAR OF EVENTS

OCTOBER

20-Nov. 3 Atomic Energy Exposition, Carnegie Endowment International Center, Nations Plaza, 46 St. & First Ave., New York City.

21-22 Permian Basin Section, Society of Economic Paleontologists and Mineralogists, Permian field conference in Guadalupe Mountains, Carlsbad, N. M.

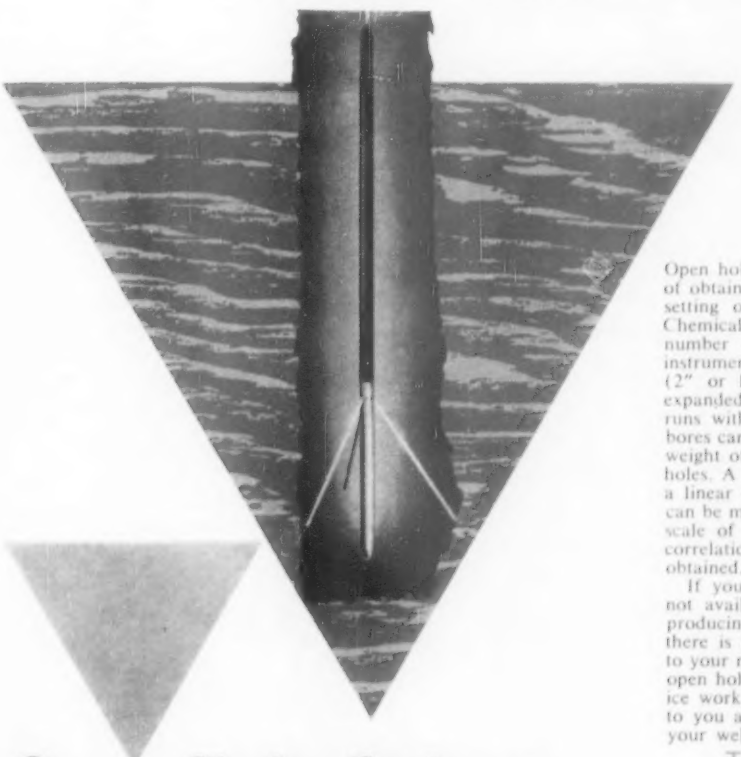
24-27 National Association of Railroad and Utilities Commissioners, natural gas panel discussion, Asheville, N. C.

27-28 Symposium on Formation Evaluation, Gulf Coast section, A.I.M.E., University of Houston.

27-29 Rocky Mountain Oil and Gas Association, annual convention, Cosmopolitan Hotel, Denver.

28 Natural Gasoline Association of America, southern regional meeting, Captain Shreve Hotel, Shreveport.

31-Nov. 1 Independent Petroleum Association of



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If you are operating old wells on which records are not available, if you have a flood project, or if your producing wells have been shot, acidized, or fractured, there is always a possibility of hole enlargement. Talk to your nearest Chemical Process Company station about open hole surveys before you undertake any future service work. They'll be glad to explain this special service to you and advise you whether it has an application in your well program.

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W-K-M Valves

America, annual meeting, Jefferson Hotel, St. Louis.

31-Nov. 2 National Lubricating Grease Institute, annual meeting, Edgewater Beach Hotel, Chicago.

NOVEMBER

2-4 American Association of Petroleum Geologists, Mid-Continent regional meeting, Skirvin Tower, Oklahoma City.

2-4 Society of Automotive Engineers, diesel engine meeting, Chase Hotel, St. Louis.

3-4 Fourth annual instrumentation conference, School of Engineering, Louisiana Polytechnic Institute, Ruston, La.

7-9 Geological Society of America, Mineralogical Society of America, Paleontological Society, annual meeting, New Orleans.

9-10 Society of Automotive Engineers, Golden Anniversary Fuels and Lubricants meeting, Bellevue-Stratford Hotel, Philadelphia.

10-11 American Association of Petroleum Geologists, Pacific Section annual convention, Biltmore Hotel, Los Angeles.

11-13 New Mexico Geological Society, in conjunction with Roswell Geological Society, sixth annual field conference, Truth or Consequences, N. M.

13-18 American Society of Mechanical Engineers, 75th anniversary meeting, Hilton and Blackstone Hotels, Chicago.

14-17 American Petroleum Institute, 35th annual meeting, Mark Hopkins, Fairmont, St. Francis and Palace Hotels, San Francisco.

18-19 Society of Exploration Geophysicists, Southwest regional meeting, Dallas.

27-29 New Mexico Oil and Gas Association, Albuquerque, N. Mex.

27-30 American Institute of Chemical Engineers, annual meeting, Statler Hotel, Detroit.

DECEMBER

1-3 Interstate Oil Compact Commission, La Fonda Hotel, Santa Fe, N. M.

1-3 American Chemical Society, 11th southwest meeting, Shamrock Hotel, Houston.

2 Natural Gasoline Association of America, Panhandle-Plains meeting, Herring Hotel, Amarillo, Tex.

8-9 Oil Industry Information Committee meeting, Biltmore Hotel, New York City.

1956

JANUARY

9-13 Society of Automotive Engineers, annual meeting, Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

16-18 Pipe Line Contractors Association eighth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

FEBRUARY

15-17 National Association of Corrosion Engineers Short Course for Pipeliners, Mayo Hotel, Tulsa.

19-23 American Institute of Mining and Metallurgical Engineers, annual meeting, Hotel Statler, New York City.

24 Natural Gasoline Association of America, Permian Basin meeting, Lincoln Hotel, Odessa, Tex.

26-29 American Institute of Cremical Engineers, Statler Hotel, Los Angeles.

27-29 American Association of Petroleum Geologists, Rocky Mountain Section, Auditorium, Denver.

AIR CLEANING
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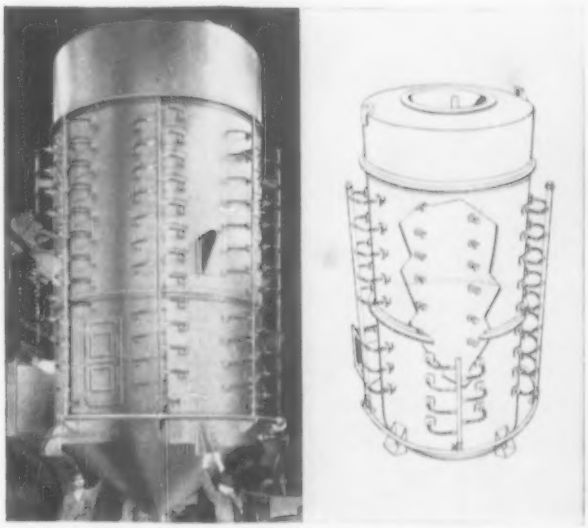

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JOURNALLY SPEAKING . . .

Rocky Field Trip

OUR occassional vacation trips to the mountains always make us wish that we had taken a course in geology, because geology seems to stick right out of the ground when you're in the mountains, and it looks quite interesting. In the national parks we always go to all the lectures by the ranger-naturalists and buy all the booklets explaining how the mountains got that way and how to tell a glacier-cut valley from a stream-cut valley. We are a firm believer in combining education with recreation.

So we looked forward with great anticipation to the meeting of the Alberta Society of Petroleum Geologists in Jasper Park, in the heart of the famous Canadian Rockies. Eagerly we signed up for the all-day field trip, with no qualms about putting the fee on the expense account because we were going to learn how oil is found.

The expedition was beautifully organized and executed. Each glass-topped bus was equipped with a loudspeaker, a lecturer, and an assistant who kept one eye on the speedometer and the other on the logbook so he would be sure which interesting sight would be next in view.

Our motorcade wound through magnificant forest carpeted with fall wildflowers, past cascading waterfalls and roaring streams, among majestic glacier-draped mountain peaks. Now and then an elk or a bear would stare at us, or beaver could be seen working in their ponds. But the lecture, as nearly as we can reconstruct it, consisted exclusively of things like this:

"We are now passing through a road cut of carboniferous age. The mountain on the right is a truncated syncline of Fernie or Cadomin equivalent overlying faulted Triassic. On strike on the left you can see the Nordegg against the Exshaw followed by the Banff and Pekisko members. The mountain straight ahead exhibits a Devonian unconformity in which the Upper Rundle is faulted against the Palliser." And so on. All day long.

We sped past breath-taking vistas without so much as a side glance in order to be on time for the scheduled stops where the road was cut through towering rock outcrops.

At each stop an amazing phenomenon occurred. The geologists poured from the buses and scrambled up the rocks, helter skelter, in every direction, pecking away with their hammers, peering through magnifying glasses, and tossing samples to one another. It reminded us of stories of the Gold Rush in the Klondike. A man at the loud-speaker truck gave a long and learned lecture at each stop, but few paid any attention. Most of them were out of earshot up the mountain, chipping off pieces. Like a swarm of schizophrenic ants they swarmed hither and thither, higher and wider over the mountain sides, tiny black specks barely visible to the naked eye. After each lecture the bus driver would honk and honk to get them to return, but we really believe that some of those rock hounds are still clambering around over those 10,000-ft. unconformities.

Silhouetted on a nearby cliff, a magnificient Bighorn ram watched us curiously while guarding his grazing flock of mountain sheep, but the lecturer paid no attention. The important thing seemed to be the unconformity of the Norquay at its juncture with the Etherington member.

We climbed the slope a little way to try to get a view over the road cut and picked up a nodule which looked to us like a fossil oyster of probably Paleozoic age, but a man nearby identified it as a hunk of frozen moose milk. We put it in our pocket anyway.

As we were getting back into the bus one man remarked to his neighbor: "There are three kinds of geologists who go on these field trips. There are some who are really interested in seeing these formations. Then there are the young eager-beavers who think they ought to learn everything about everything. And then there are geologists, like me, who don't give a damn but just want an excuse to get away from the office for a couple of days."

That classified us. Anyway, we enjoyed the ride.

Later we bought a nontechnical, illustrated booklet on the geology of Canadian National Parks in the Rocky Mountains. Some day we intend to read it. Maybe next spring. From now on we're going to get our education and recreation separately.

—*Henry D. Ralph*

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How to get more oil technologists

SOME startling facts about a basic problem of the oil business were presented in last week's Journal. There aren't enough engineers and other technically trained college graduates to operate the oil industry and keep it progressing. And there is little prospect of improvement.

An industry so dependent on education should do something about it. It has done something, but at only one end of the educational system. Oil has contributed generously at the engineering-college level in endowments, scholarships, research grants, and other aids.

Now it is becoming clear that the basic trouble is a shortage of young men with a desire to enter engineering colleges and who are properly prepared for technical studies. Our primary and secondary schools just aren't doing the job required to keep American industry advancing.

HERE'S WHERE OIL MEN SHOULD "meddle in politics" —if you want to apply that term to participation in the civic function of supervising public education. This participation should range from attending P.-T.A. meetings to pressuring state legislatures for needed improvements.

But this should be done under an industry-wide program and a coordinated plan of action. Criticizing and deploring won't do any good. Sporadic action by a few companies won't do enough. It's an industry problem and should be handled as such.

The A.P.I. or some such group should sponsor a vigorous program for improving training in science and mathematics at the high-school level. First, make an objective analysis of what is wrong. Second, develop a constructive program for improvement. Third, guide individual oil men and companies in tackling this grass-roots problem at the community level.

RUSSIA IS TURNING OUT 2½ times as many scientists and engineers as the United States. European schools are said to give much better scientific preparation than American grade and high schools. Our educational system needs the kind of reorientation that the oil industry can give if it will.

Our schools are currently under criticism from many quarters. People talk of a crisis in education. So now is the time for constructive thought and action in industry. And oil can help itself by leading the way.

Engineers are made, not born, and the making starts when they are kids. If the oil industry is going to have the supply of technical men it needs it must take an active interest in seeing that production is kept in balance with demand.

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Current and significant in . . .

The Industry This Week

Offshore

• **Oil exploration in the Gulf of Mexico** is moving farther out to sea. Shell Oil Co. has staked location for a test 63 miles off the Texas coast. That's 23 miles farther out than Phillips' current test off Louisiana, the previous record holder. Water is 93 ft. deep. P. 66.

The latest in drilling platforms, capable of operating in 100 ft. of water or deeper, soon will be launched by Zapata Off-Shore Co. The general-purpose platform, built by R. G. LeTourneau, Inc., at Vicksburg, Miss., will be equipped for deep drilling in the Gulf of Mexico. Cost: $2,000,000. P. 61.

The Government isn't giving up its claim to submerged lands beyond Louisiana's 3-mile limit. The Supreme Court's refusal to fix the boundary there is regarded as merely a procedural decision delaying final judicial determination. P. 61.

Production

• **Spraberry is booming again.** And there's not a single drilling rig involved. The new excitement in the huge West Texas area is from the spread of Clear Fork pay.

With 40 recompletions made and 25 others scheduled, the new pay promises to put many red-ink operations in the black. Geologists believe it may extend over the south two-thirds of the 400,000-acre area. P. 56.

Government

• **A federal judge in Topeka** will soon decide whether a state agency can kill the sale of a pipeline. He also will determine whether a crude purchaser can be forced to buy oil at a specified price. The two questions stem from the proposed sale of two Sinclair crude lines to a group of Kansas producers. P. 60.

Offshore operators want relief from transportation taxes. They claim Congress never intended them to bear the 3 per cent levy assessed against the small fleet of boats used to haul men and equipment to and from offshore locations. P. 70.

Imports

• **The Government may bypass import quotas** in favor of some other approach to the problem. No definite policy has been set, but some influential sources are talking other solutions. New U. S. refineries based on Canadian crude and increased sales by major importers to others who then bring it in are blamed for the jump in imports this year. P. 72.

Crude imports hit an all-time high in August. They reached 845,000 bbl. daily. The record month also saw Canada climb to fourth among countries exporting to the United States. P. 71.

Industry

• **California's first crude-price increase** since February 1953 is now in effect. California Standard was the leader with new postings for heavy crude.

The increase ranged from 1 cent for 26° oil to 10 cents for 14° and heavier. Other majors immediately followed suit. The price boost covers more than half the state's production. P. 73.

El Paso Natural Gas Co. is already in the drilling, producing, and pipelining ends of the business. Now it's going into refining and marketing. El Paso is buying McNutt Oil & Refining as a first step to find outlets for its big natural-gas liquids production. P. 59.

Optimism replaces pessimism as . . .

. . . New Pay Spreads in Spraberry

- **The skimpy Clear Fork may turn red-ink wells into profit makers for many**
- **Already there have been 40 recompletions, and many more due this month**

Robert J. Enright

MIDLAND, Tex.—It now appears that a rather poor shallow pay, the Clear Fork, is going to bail out a great many operators in the immense Spraberry Trend producing area of West Texas.

The Clear Fork, however ill-regarded on its own merits, looks like a gold mine to those operators who have been waging a losing battle to achieve a payout from the trend's baffling Spraberry sand pay.

Where production is established in the new and shallower horizon, the operator most likely will break even or perhaps make a small profit. Before, he was confronted with a substantial loss.

And this small Clear Fork production, added up well by well, will mean that many more millions of dollars in oil will be produced from the trend before it is through.

So far nearly 40 wells have been completed in the Clear Fork. Production from the zone has spread over nearly 100,000 acres in Spraberry's fat central region where Midland, Glasscock, Upton, and Reagan counties join.

Another 25 or so Spraberry producers were ticketed for recompletion in the Clear Fork last week. Most geologists believe the new pay may eventually spread over the entire south two-thirds of the area's sprawling 400,000 acres.

This doesn't mean that every Spraberry well in this huge area is a cinch for the Clear Fork, too. There have already been a few recompletion failures in wells virtually surrounded by Clear Fork producers. It means just that geologists feel this whole area is favorable for such production based on cross sections and other data.

These cross sections indicate, as a matter of fact, that the best Clear Fork production may develop in the Pembrook area to the Southwest of that already established in the Driver, Midkiff, and Weiner-Floyd areas.

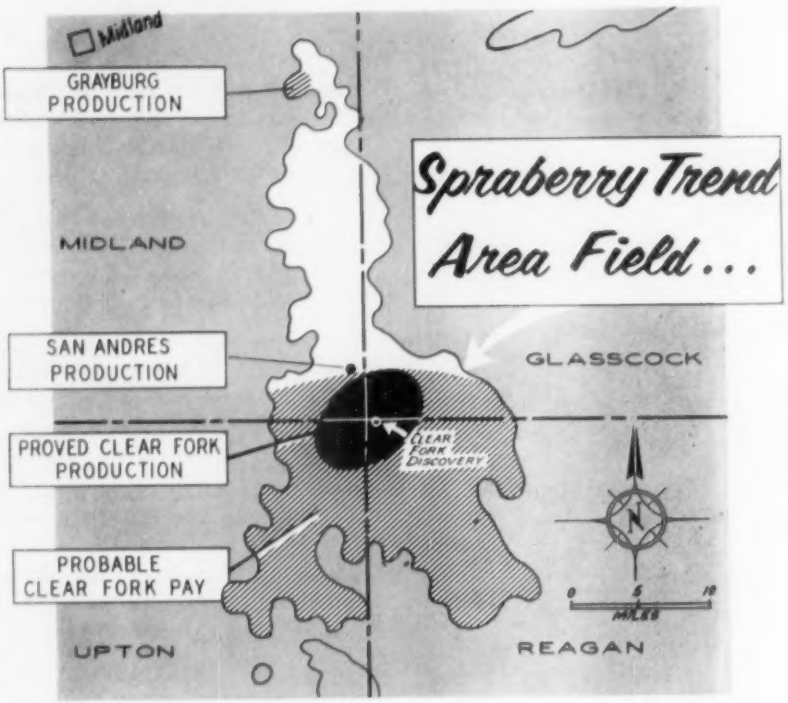
Why so important . . . Discovery of the Clear Fork pay by Rowan Oil Co. at its 1 Frank Schwertner et al in extreme northwest Reagan County last June touched off probably the strangest boom in oil history.

There are no drilling rigs involved—only logging, perforating, and acidizing units and other service-company facilities.

The rush to complete in the Clear Fork suggests how badly things have been in Spraberry. The Clear Fork stringers average only 10 ft. thick, compared with Spraberry's 1,000 ft., and are expected generally to have a short producing life.

The Spraberry sand, a hard siltstone-like pay, has produced a whopping 90,000,000 bbl. of oil. That's a lot of oil, but it isn't much per acre or per well. The pay generally is giving up less than 1,000 bbl. of oil per acre and less than 40,000 bbl. per 40-acre well. One large firm says its recoveries are closer to 600 bbl. per acre and 24,000 bbl. per well. Another is getting only 380 bbl. per acre and 15,000 bbl. per well.

Spraberry wells cost roughly from $85,000 to $125,000. A 40-acre well producing 30,000 bbl. of oil would gross considerably less than the cost of drilling the well, not even considering operating costs.



The Texas Railroad Commission has been sympathetic. First it permitted drilling and production on 80-acre spacing rather than 40 acres; recently it hiked the penalty boundary for gas-oil ratios from 2,000:1 to 4,000:1 *(The Oil and Gas Journal, June 13, page 127, and August 8, page 69).*

A hike in the price of crude oil in mid-1953, added income from conserved casing-head gas, and the advent of artificial fracturing, especially the fairly recent high-velocity frac treatments helped too. But even these aids can't help recover oil that isn't there.

Moreover, most operators feel that they can't economically get more of Spraberry's limited oil lode via presently known methods of pressure maintenance or secondary recovery due to the tightness of the sand.

To many of these operators then, something like the Clear Fork is about the only hope. With the hole already there, the Clear Fork oil above looks like so much gravy, since it is available with only a relatively small cash outlay for completion.

What about this pay? . . . The Clear Fork horizon in the trend area has little structure. Geologists generally term it a stratigraphic trap in the form of a monoclinal fold.

It is topped at about 5,900 ft. at its shallowest in Glasscock County. It deepens to the south and west to where its top is believed to be about 7,000 to 7,100 ft. in the Pembrook area before it begins to rise again.

It conforms geologically almost exactly to the Spraberry, which is topped at depths ranging from about 6,600 ft. to almost 8,000 ft. One geologist terms the new pay an "echo of the Spraberry."

A minor discrepancy is that the Clear Fork thickens into an almost reef-like formation in a small area in Glasscock County along the eastern edge of the present play.

There are three main stringers of Clear Fork pay with minor streaks appearing and disappearing in various areas. One stringer is more prominent and continuous than the others. Thickness generally is from 5 to 20 ft.

The pay is believed by most geologists to pinch out in the Driver area just to the north of present northern Clear Fork limits.

There are other similarities besides structure between the Clear Fork and the Spraberry. Both are heavily fractured. Oil in both is believed to be mainly in these fractures. Porosity and permeability are generally low.

The Clear Fork, however, is a dark shaley dolomite, while the Spraberry is a siltstone. An X-ray analysis of a Clear Fork core showed it to be 8 per cent alpha quartz, 17 per cent amorphorous, and 75 per cent calcite.

Clear Fork oil generally runs 1° to 2° higher in gravity than that from the Spraberry. Also like Spraberry oil, the Clear Fork crude is a sweet oil. The latter characteristic in part has led to a theory held by some geologists that oil now in the Clear Fork horizon some time in the past migrated up from the Spraberry. This is due to the fact that most Clear Fork pools in the Permian area produce sour crude.

The Clear Fork producer . . . The average Clear Fork well has been potentialled for about 200 bbl. a day (some as high as 400 bbl., a few completed as 50-bbl. pumpers). It has a bottom-hole pressure of about 1,950 to 2,050 psi. and a gas-oil ratio ranging from about 500 to 800 cu. ft. per barrel.

Its allowable is 91 bbl. per producing day or about 45 bbl. per calendar day.

Present estimates of ultimate primary recovery vary widely—from as little as 12,000 bbl. to as high as 80,000 bbl. per 80-acre well.

Most feel, however, that 30,000 or 40,000 bbl. per 80-acre well will come pretty close. One reservoir expert estimates on the basis of other Clear Fork production in the basin that producing life will be fairly short. He expects a flowing life of about 15 months.

THE FIRST MAJOR FRACTURE JOB for the Clear Fork in Spraberry field was conducted last week by Dowell Incorporated. Tests indicated the well will make a good pumper.

It appears that reservoir energy, as in the Spraberry, will be of the solution-gas type. This, however, won't be known for sure until the field is more nearly defined.

If the typical Clear Fork well should produce 40,000 bbl. of oil before it dies, it would gross roughly $115,000. Recompletion costs to date have run from about $5,000 to $7,500 for a mere plug-back to around $15,000 or more for a dual completion.

Added to an operator's cost of production, this still would leave him a tidy sum to help him out of the hole he got into when he drilled his Spraberry well.

How they're recompleted . . . So far, conventional Clear Fork completion procedure has been to perforate, wash the exposed formation with about 500 gal. of mud acid, and then to acidize conventionally with 1,000 to 5,000 gal.

However, it has been found that many former Spraberry producers either weren't cemented up past the Clear Fork or that the original cement jobs were faulty. When an operator perforated the Clear Fork, mud left behind the casing drained into the hole. He then had to squeeze cement above and below the formation to isolate the pay zone.

Some now are using radioactive mud acid in the first stage together with electric pilot tools to determine whether the acid is treating the pay zone or dispersing behind the pipe.

In all but one case to date this treatment has been sufficient to kick the well off. Fracturing jobs haven't been used in the Clear Fork, despite the general belief that most of the oil is in fractures and that fracturing probably would hike the oil flow.

Reluctance to fracture is due mostly to fear of what might happen in such a pay zone sometimes only 5 ft. thick. Another reason might be that Spraberry operators have become so economy conscious they hesitate to risk a sizable frac job when a well already is producing satisfactorily.

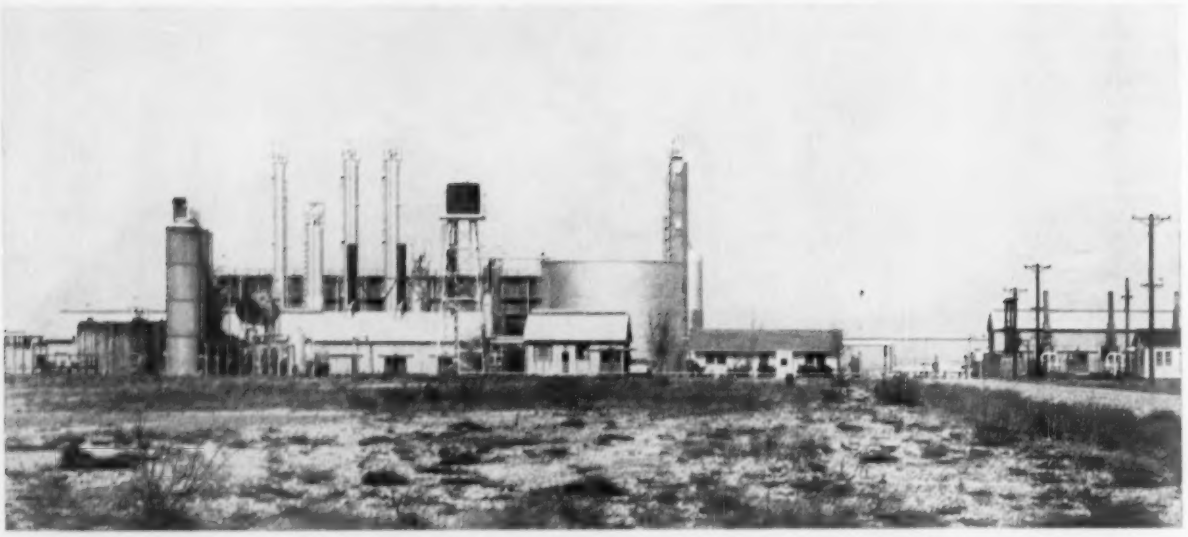
An operation last week in Reagan County may change this pattern, if successful. This was Hanley Co.'s TXL D2 in Section 39, Block 37, Township 5s.

The TXL D2 refused to produce any oil after the conventional mud acid-regular acid treatment. The well was fractured October 15 with 20,000 gal. of fluid and 20,000 lb. of sand.

At midweek the well had recovered load oil and most of the acid water. It was swabbing about 10 bbl. of fluid an hour, about 70 per cent of it oil. More testing will be necessary before the job can be termed successful. But it now appears that the well will make a fair-sized pumper.

Dual completions . . . Roughly 60 per cent of present Clear Fork producers have been simply plugged back from depleted Spraberry pay. The rest have been completed as dual producers from Clear Fork and Spraberry.

Neither the Clear Fork nor the Spra-



SPRABERRY GASOLINE PLANTS have seen little change in gas volumes for Spraberry wells. Permissible gas-oil ratio recently was increased from 2,000:1 to 4,000:1, and plant operators feared an additional load would be thrown on their already burdened plants. Producers thought gas output would actually drop. The next few months will tell.

berry in present dual completions has sufficient pressure to flow through the casing-tubing annulus, so two strings of tubing have been used.

Nearly all Spraberry wells were completed originally with a 5½-in. oil string. This means that there's not sufficient room for two ordinary strings of 2½-in. tubing.

Operators so far have met this problem in three ways—by running:

. . . **One string** of normal 2½-in., one string of hydril tubing.

. . . **Two strings** of milled-down 2½-in. tubing (collars machined down).

. . . **One string** of 2½-in. and a string of 1¼-in.—the latter usually for the Clear Fork production. This has proved unsatisfactory in some cases due to paraffin accumulation in the small string.

Some operators say they can't justify the expense of a dual completion requiring two strings of tubing. This consideration is believed to be a big reason that Clear Fork production hasn't spread even faster.

One producer told the Journal he intends to shut in Clear Fork production until the deeper Spraberry zone is depleted.

His hope is that by that time there will be enough producers with only Clear Fork oil to persuade the Texas Railroad Commission to grant higher allowables. In fact, a move already is under way to secure higher Clear Fork allowables.

Why the delay? . . . Those not familiar with Spraberry development have asked why the Clear Fork play was so long in coming.

There are many reasons. Here are some of them:

. . . **It was found noncommercial** when first tested in the Old Tex Harvey area. This was in the northern part of the field early in the Spraberry play. This perhaps led to some disregard of the formation when the play moved southward.

. . . **Electric logs were not dependable,** due to the Salvado salt formation. This is a thick and extensive deposit occurring at shallow depth over most of the area. The salt contaminated drilling fluid and in most cases rendered electric logs then employed almost useless.

. . . **Too few formation samples** were taken in critical areas. Because of lost-circulation trouble, cottonseed hulls and similar materials were used in the mud. Shale-shakers, where samples ordinarily are caught, were bypassed during periods of circulation difficulty.

Other prospects . . . Spraberry producers eying two other shallow pays in the trend area as possible boons to the field.

These are the Grayburg and the San Andres.

Developments to date, however, indicate these are either small isolated pools or that other production from the zones, if any, probably will be in the form of similar small porosity lenses.

Grayburg production was opened in July 1952 by James H. Snowden's 2-12 Hale at 3,940-60 ft. in the Germania area in the far northern portion of the trend.

The Germania area now boasts about 20 Grayburg producers on about 2½ sections. These came in for about 70 to 135 bbl. a day and have settled down to pumping about 50 bbl. a day.

Tests to the east have not found the Grayburg commercially productive, but it's possible that other producing areas may be established in the trend.

The same is true of the newer San Andres production. Roy Furr made this strike September 20 in the Driver area.

The discovery, the 1-G J. W. Driver 20 miles southeast of Midland, came in for a daily pumping potential of 104.4 bbl. of 30°-gravity oil from open hole between 3,824-44 ft. Since then two offsets have been completed.

It's too early to determine the producing extent of the San Andres, but geologists don't think it will prove nearly so important as the Clear Fork.

One dampening factor was a look which Magnolia Petroleum Co. took at the San Andres only about a half section east of the Furr discovery well. The company said it found nothing which could justify a drill-stem test of the San Andres.

Geologists aren't unanimously agreed, as a matter of fact, that Clear Fork production won't be found in the Tex Harvey area and others north of present production. One large firm plans tests in Tex Harvey in both the Clear Fork and the Grayburg.

At any rate, Spraberry operators are looking hopefully, and in many cases optimistically, at prospects for picking up sufficient oil from these shallow pays in the trend to finish paying for holes long-since drilled.

A few feel that these prospects are so good that many of the trend's thousands of proved but untouched Spraberry locations might eventually be drilled and that the monumental Spraberry water-haul might not prove so disastrous after all.

El Paso Natural Expands

Big pipeline adds refining, marketing to drilling and producing activity by purchasing McNutt Oil & Refining

EL PASO, Tex.—El Paso Natural Gas Co., a southwestern pipeline giant with drilling and producing activities, appears on its way to becoming a significant refiner and marketer of oil products as well.

The company is cutting the last legal red tape in the process of buying McNutt Oil & Refining Co. of El Paso.

McNutt, a small refiner and marketer in West Texas, New Mexico, and Arizona, has a 3,200-bbl. refinery at Brickland, N. M., seven terminals, and 125 retail outlets.

Paul Kayser, El Paso president, termed the pending purchase El Paso's "first step" in a long range program aimed at finding the best market for the company's large production of natural gasoline, butane, propane, and other liquids.

El Paso has roughly 25,000 bbl. daily of such products. About half the output is concentrated at its big Driver gasoline plant in Spraberry Trend Area field in West Texas. Another third comes from plants in the San Juan basin, and the rest from scattered plants in the Permian basin of West Texas and New Mexico.

Hints by El Paso officials indicated that the company eventually plans to refine and market on its own virtually all of its gas-liquids production.

The McNutt refinery at Brickland now could consume only a fraction of this volume in blending operations. Kayser said El Paso expects to expand McNutt operations to furnish added outlets to market these products.

Expansion plans pending . . . Kayser said expansion plans haven't yet been fully developed but he left the impression that the building program might not be confined to the Brickland plant.

Preliminary plans for the Brickland expansion, he said, should be ready within a month.

Kayser did not disclose what new facilities are planned at Brickland. It was believed they likely will include reforming, which might permit direct processing of gas liquids in addition to blending.

El Paso for several years has sought a profitable means of disposing of its large natural-gas liquids production. At one time the company looked into the possibility of injecting products into the crude stream of a big-inch oil line planned from West Texas to California by West Coast Pipe Line Co. That project was then and still is stymied by lack of financing. The idea was that the gas liquids would raise gravity of the crude stream and make it more acceptable to California refiners.

Purchase terms . . . El Paso will acquire McNutt by exchanging 49,450 shares of its common stock for the entire 150,000 shares of McNutt common on an approximate 1-for-3 basis.

Kayser said there appear to be "no insurmountable difficulties" and the exchange of stock should be completed in the near future. A listing of the stock involved in the deal is being prepared and will be submitted to the New York Stock Exchange.

McNutt Oil & Refining was organized under its present name in 1932 by the late C. M. McNutt. C. Blaine McNutt is president and general manager.

The Brickland plant has a crude charge capacity of 3,200 bbl. daily, 1,200 bbl. daily of thermal cracking, a 600-bbl. Platforming unit, and a 40-bbl. catalytic polymerization unit.

Arizona Oiler Indicated

WINSLOW, Ariz.—Humble Oil & Refining Co. has completed what could be Arizona's first commercial oil producer.

The well is 1 Navajo Tribal in the Four Corners area in Apache County. On 7-hour test through ½-in. choke, it flowed 37.9°-gravity oil at the rate of 65 bbl. a day and gas at the rate of 4,385 M.c.f. daily. Producing interval was 4,806-16 ft.

Last December Shell Oil Co. brought in a gas well, 2 East Boundary Butte, ¾ of a mile northeast of the Humble well. On 24-hour gage, the Shell discovery yielded 5,200 M.c.f. of gas from perforations at 4,540-4,690 ft. in the Pennsylvanian. The well has been shut-in pending completion of a pipeline outlet.

On the basis of earlier tests, the Shell well made Arizona the thirtieth producing state. Initial flow was 2,200 M.c.f. of gas daily through a ⅜-in. choke from plugged back depth of 4,884 ft. During a 13-hour test, the well produced fluid at the rate of 32 bbl. daily, including 11 bbl. of oil *(The Oil and Gas Journal, November 1, 1954, page 58).*

Processing Briefs

LOS ANGELES.—Standard Oil Co. of California has offered to buy the Hawaii refining facilities of Pacific Refiners, Ltd., for $2,425,000. Directors of Pacific Refiners have approved the sale. It now awaits favorable vote of the stockholders. Standard has not indicated how the purchase would affect its plans for building a $30 million, 25,000-bbl. refinery in Honolulu. The Honolulu Planning Commission already has tentatively approved a site on Sand Island for the plant.

TULSA.—DX-Sunray Oil Co. last week sent the first charge to its new 7,000-bbl. delayed coker following several days spent testing the unit at its West Tulsa refinery.

The delayed coker will charge 7,000 bbl. daily of reduced crude for a coke production of 240 tons daily. The unit was designed by M. W. Kellogg Co. It was erected by DX-Sunray's engineering department.

TEXAS CITY.—Monsanto Chemical Co. plans a multimillion-dollar expansion of ethylene production facilities at its plant here. Construction will start next March with completion early in 1957. The plant here uses ethylene as an intermediate in manufacture of polyethylene, styrene monomer, and and vinyl chloride monomer.

NEW YORK.—General Aniline & Film Corp. plans to build a nonionic surfactants plant at Calvert City, Ky. The plant is scheduled for completion next July. The operation will be based on acetylene, which will come from a plant General Aniline is now building at Calvert City.

BARTLESVILLE, Okla. — Phillips Chemical Co. will expand its Borger, Tex., copolymer plant by 22 per cent, in addition to the 15 per cent expansion announced recently. Capacity is 63,000 long tons of synthetic rubber a year. Phillips announced the additional butadiene will be obtained by expanding the adjacent plant.

HOUSTON. — Petro - Tex Chemical Corp. has awarded Bechtel Corp. a contract to increase the capacity of its butadiene plant here from 90,000 short tons to 135,000 short tons yearly. Bechtel will begin work on the project immediately and expects to be through by the end of 1956. Petro-Tex is owned by Tennessee Gas Transmission Co. and Food Machinery & Chemical Corp.

State's Power Tested

Sinclair challenges Kansas' right to halt pipeline sale or force crude buying; U. S. court may decide vital issues

W. A. Bachman

TOPEKA, Kans.—Can a state agency halt the sale of a pipeline? Can it order a crude purchaser to buy oil in the field at a price it dictates?

These vital questions about the extent of a state's authority over the oil industry suddenly emerged here last week before U. S. Judge Delmas C. Hill. Principals were the Kansas Corporation Commission and the pipeline and crude-purchasing subsidiaries of Sinclair Oil Corp.

The dispute involved movement of only about 5,000 bbl. daily of crude in southeastern Kansas. But its legal significance was sweeping.

Other oil companies kept close watch on the outcome after Sinclair brought the case into federal court for a test.

How it started . . . Sinclair Pipe Line Co. had completed arrangements to sell two of its 8-in. lines from Paola to Humboldt, Kans., and from Eureka to Humboldt. Buyer was Producers Pipe Line Co., Inc., of Iola, Kans. It was a company formed by independent producers of the area.

Producers planned to operate the Paola line, tendering crude at Humboldt to Sinclair Crude Oil Co. It proposed to abandon the Eureka line. But the new firm had arranged with a trucker to haul the crude to Sinclair at no cost to the oil producers.

The Kansas Corporation Commission, however, on September 28 ordered Sinclair to delay sale of the pipelines. It later ordered Sinclair to resume its oil purchases in the field at the prevailing price. It backed up its actions with a restraining order obtained in Shawnee County district court.

The commission stated it acted on petition of producers in the Eureka area opposing abandonment of that line. The oil men, according to the commission, contended the move was not in the public interest and would boost their transportation costs. The commission ordered the sale delayed until it could determine if it had jurisdiction in the matter. A public hearing was set for November 8. It said it ordered buying and transporting resumed to avoid hardship on oil producers.

But the result was a shutdown of oil movement from the fields on October 1, date set for transfer of the pipelines.

Most of the wells were either marginal producers or water-flood projects. Some operators trucked their crude to market at Chanute, Kans. Others shut in the wells with a $14,000 daily loss.

Conferences failed to break the deadlock. Representatives of Sinclair, the oil producers, and the state studied several proposals to relax the commission orders. They wanted the oil moved without jeopardizing the legal position of all parties. Nothing resulted.

Sinclair subsidiaries then on October 14 went before Judge Hill seeking an injunction. They asked that the Corporation Commission and the Kansas attorney general be temporarily restrained from interfering with sale of the pipelines and movement of the oil. They also asked that general legal issues involved be placed before a three-judge federal tribunal for decision.

The court's ruling . . . Judge Hill issued two temporary injunctions covering:

. . . The pipelines. He enjoined the state from interfering in transfer of the two pipeline properties, including abandonment of the Eureka line.

. . . Oil movement. He ordered state authorities not to interfere with oil-buying activities of Producers Pipe Line and told the pipeline to proceed with buying and transporting to Sinclair.

In addition, Judge Hill took under advisement Sinclair's request for the three-member court to pass on legal issues. He is expected to decide on the matter soon. If the court is convened, it must decide whether a state agency can step in to halt sale of the pipeline and order Sinclair to continue buying crude at a certain price.

Crude began moving almost immediately after Judge Hill's orders. Producers began pumping 8,200 bbl. daily of distress oil over the Paola line.

The present plan . . . Walter Fees, Iola, Producers president, said he expected the pipeline run to return to its normal 4,700 to 5,000 bbl. daily this week.

He said Marvin Boyer, Iola trucker, notified producers on the Eureka line he would transport their oil to Sinclair terminals. Under Judge Hill's order the Eureka line will remain closed.

Sinclair Crude will buy oil from Producers at Humboldt in 35,000-bbl. tenders. Sinclair turned over its two 35,000-bbl. storage tanks at Humboldt to Producers as part of the sale agreement.

Sinclair agreed to pay its posted price of $2.90 a barrel for 40°-gravity crude at Humboldt. In addition it will pay Producers 10 cents extra for pipelining the oil from Paola. Producers will buy the crude in the field at $2.85.

Producers has arranged with Boyer to buy oil formerly shipped on the Eureka line at $2.85 per barrel for 40°-gravity. Boyer will truck to Sinclair Pipeline probably, in the Virgil area, where he will receive $2.90, taking the 5-cent spread to cover his costs.

Sinclair subsidiaries claim the delivered oil will cost them the same. But they see some benefits to them in the new arrangements. They are relieved of operating two small pipelines which had become uneconomical. Some saving will be effected also by not having to keep records on purchases and oil and royalty payments from the 300 leases along the two lines.

What's involved . . . Declining production from the southeastern Kansas fields and increasing operating costs prompted Sinclair to sell the pipelines. Runs on the Paola line averaged 4,700 bbl. daily. An average of 266 bbl. daily comes over the Eureka line.

Producers Pipeline probably will do well to break even on its operations. Fees said his group didn't want to get into the pipeline business but did so to preserve its market.

Oil observers place vast importance on the legal tussel. A precedent could be set for other pipeline carriers faced with an uneconomical line and producers wanting to buy to keep open an outlet. Almost as important is whether the state can order a company to buy crude at the prevailing price.

The disagreement . . . The Kansas Corporation Commission contended it ordered the delay in sale of the pipelines to investigate complaint of Eureka producers. When oil buying and movement ceased October 1, the commission ordered normal buying resumed to prevent physical and economic waste and protect correlative rights.

It claimed it had jurisdiction over Sinclair Crude Oil Co. because it is a buyer of crude in Kansas under provisions of the state general statutes. It was uncertain about its jurisdiction over Sinclair Pipe Line, but had called a meeting for next month to determine its legal position.

Sinclair claims its pipeline is an interstate system and is not subject to jurisdiction of the Kansas Corporation Commission. The company also reported that all producers affected by the sale would have been assured a market and transportation.

William H. Morris, Sinclair Pipe Line president, said his firm considered the federal court move the quickest method to determine the legal issues.

New Suit Coming

U. S. to pursue its claim to area off Louisiana coast

WASHINGTON.—The Government's claim to the submerged lands beyond Louisiana's 3-mile limit is not going to be dropped.

A high Interior Department official last week said the Supreme Court's recent refusal to make a quick decision was only a "procedural decision." It served only to delay a final decision based on facts, he said.

The Justice Department asked the high court last summer to dispose of the boundary issue by modifying its 1950 decree giving the federal Government "paramount rights" to submerged resources beyond the state's low-water mark.

That decision was nullified by Congress in 1953, when it held that the coastal states were entitled to everything within their "historic" boundaries.

The department said the court would have to modify its decree to conform to the 1953 law. In doing so, it said, it should rule that Louisiana's historic boundary was 3 miles, not the 3 leagues claimed by the state. The state argued it was entitled to a full hearing before the boundary was decided. The court denied the department's petition, but said nothing about the merits of the Government's claim.

As a result of the court's rejection, the Government now will have to start new proceedings in a federal district court if it presses the case. The Interior Department spokesmen indicated that Secretary Douglas McKay will not be satisfied to let it lie.

"We shall continue our efforts to obtain a decisive ruling on this question," he said.

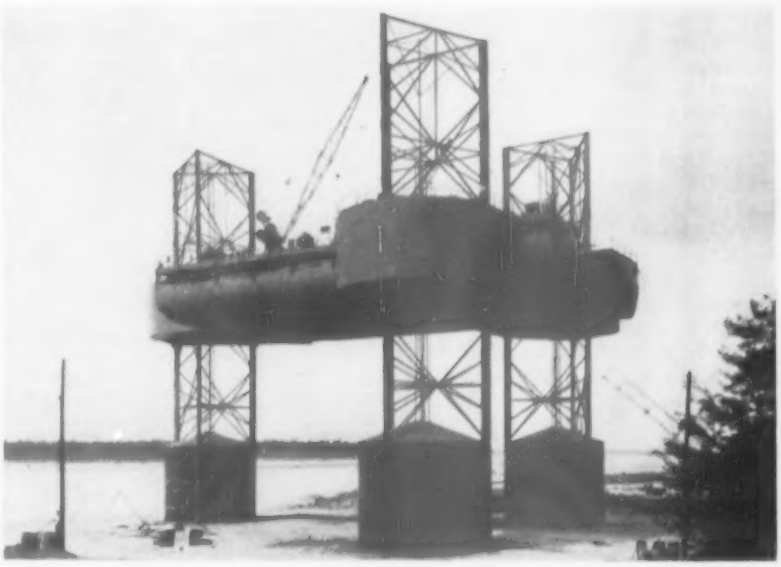
Panhandle Loses Court Bout

WASHINGTON.—Panhandle Eastern Pipe Line Co. lost a decisive round last week in its fight to halt the building of the American Louisiana pipeline.

For the second time, the Supreme Court refused to review the decision of the Third Circuit Court of Appeals at Philadelphia not to set aside the Federal Power Commission's approval of the new line to serve the Michigan area.

Panhandle went to the high court last spring after losing out in Philadelphia. In May, the court refused to hear the case and Panhandle asked it to reconsider. American Louisiana, however, went ahead with the building of the line and had part of it laid when the court again denied a hearing.

Newest in Platform Ideas . . .



. . . Nearly Ready to Go to Sea

VICKSBURG, Miss.—The latest in drilling platforms built to conquer record ocean depths will soon be floated down the Mississippi to the Gulf of Mexico.

The 4,000-ton platform was built by R. G. LeTourneau, Inc., to operate in water over 100 ft. deep. Priced at $2,000,000, the first of the new structures will be equipped for deep drilling by Zapata Off-Shore Co., Houston. Launching will be in about 2 weeks.

The platform sits on three 140-ft. legs. They are lowered after towing to the drilling site. Sixty-three electric motors with gear-reduction of over 1,000:1 raise the floor to the desired height above water. The deck covers more than half an acre. It has pipe and tool storage, supervisors offices, and air-conditioned quarters for 42 men. The builders claim the platform is stormproof, and easily moved, yet costs no more than permanent-type installations.

Its capacity compares with platforms now on the drawing boards designed for 200 to 300-ft. depths.

Frac Work Picking Up

New techniques successful in California; higher injection rates force greater load of sand into thick formations

D. H. Stormont

LOS ANGELES.—Hydraulic fracturing is becoming more successful and more widely used in California oil fields. This development stems from new procedures for coping with the thicker, shaley, and higher pressure producing formations found in the area.

One key reason for the higher success ratio was revealed here last week. It is the ability to obtain sufficient injection rates to carry large volumes of sand into the formation.

V. R. Young of Halliburton Oil Well Cementing Co. made the report. He was one of six speakers discussing the topic before the annual meeting of the Southern California petroleum section of A.I.M.E.

In California the average treatment requires 34,000 lb. of sand mixed with 18,000 gal. of fluid. In some wells 40,000 to 80,000 lb. of sand are used. Elsewhere in the United States the trend is to use an average of 11,500 lb. of sand and 7,400 gal. of fluid, Young said.

The problem . . . Thick producing sections, a characteristic of California fields, were first considered impractical for fracturing. The problem was further complicated by the way in which wells are completed in the soft, interbedded formations. In most cases there is no isolation of sands from thick shale sections. But the unusual behavior of the thick sections, when subjected to high pressures and injection rates, may be the reason for the increased success.

California shales, Young observed, differ greatly from those in the Mid-Continent. These are generally in thin layers and contain many fine fractures. The contact between sand and shale is a relatively sharp change. California's shales are more like siltstone. There is a less pronounced gradation from sand to shale. They thus are probably more pliable than the brittle, easily fractured Mid-Continent shales.

Attemps to trace fractures have indicated they were in the more permeable sections of the formation. Wells with thick sections that add up to many feet of exposed shale have responded nicely, he said.

It may be then, the shales are pliable and dense enough that they give and absorb the energy expended against them. The sands can only react to a lesser degree and soon break, according to Young.

What about fluids . . . Fracturing fluids used in California fields also have been a problem, Young related. Acid type gels and emulsions used in Mid-Continent fields led to secondary troubles in California wells. Attempts were made to stimulate wells by various washes. But this indicated caution had to be used when exposing the formation to foreign fluids to prevent plugging.

Solution has been the development of an economical means of gelling the crude from the well to be fractured. Viscosity of the gel is not greatly affected by the higher temperatures or pressures encountered. No detrimental effects have been observed in any of the wells treated with the gel, he declared.

Obtaining a fracture large enough to accommodate large volumes of sand is being accomplished in two ways. Shallow wells are "over-horsepowered" (that is, excessively high pressures are developed for the depth.) This is gained by high injection rates without exceeding reasonable working limits.

Overcoming the excessive pressures met in deeper wells requires special handling and materials, Young stated. Low fluid-loss materials and viscous gels have been used to plug the formation before a break was attempted. Plugging the formation, then subjecting it to high pressures and injection rates has resulted in reduced injection pressures.

Shell largest user . . . Experiences of Shell Oil Co. were described by J. L. Bowen of that company. As of last June, a total of 42 jobs in 22 California wells had been performed by Shell. This was 25 per cent of all hydraulic fracturing in the state. Of the wells treated, 58 per cent resulted in sustained increases and are judged commercially successful, Bowen said.

The increased production will make fracturing pay off, Bowen declared. He explained that $264,600 net already has been returned from total expenditure of $373,600. The treated wells are still producing 320 bbl. more oil daily than would have been anticipated had fracturing not been attempted.

Brea-Olinda, with 29 treatments on 12 wells, probably has the most fracturing experience of any California field. These he summed up as follows:

In six months the 10 wells fractured have recovered approximately 47,000 bbl. more oil than they would have produced without fracturing. Results do not appear to be spectacular. But most of the wells treated appear to be leveling off at production rates greater than those before treatment. Decline rates are comparable to those established before treatment.

All wells fractured were pumping. Those specifically completed for fracturing were gun perforated in about 50-ft. sections. Each interval then was

LAGCOE Draws 25,000 Visitors Daily

Exhibitors last week termed the first Louisiana Gulf Coast Oil Exposition a huge success. The 4-day exhibit, held at Lafayette, La., drew an estimated 25,000 visitors each day it was open. Nearly 200 oil companies, manufacturers, and service firms displayed everything from mobile rigs to computing machines, from drilling mud to aerial maps and diamond bits.

separately fractured. In those completed with a perforated liner opposite the producing section, the entire interval was fractured by a two-stage treatment. A bridging agent was used between stages in an attempt to effect two fractures. These longer intervals, some of which were in excess of 1,000 ft., contained a considerable amount of interbedded shale.

Brea has its fracturing problems, too. They were described by Bowen as:

. . . Inability to inject all the sand desired into the fracture. After injection operators often were unable to prevent amounts of it from flowing back into the well bore. Experience to date indicates that low concentrations of sand and more viscous carrying agents are better in preventing sand-outs.

. . . High injection pressures encountered. In many cases these pressures approach the strength of the tubing and casing. They prevent use of the high injection rates sometimes necessary to create fractures and prevent sand outs.

Other cases . . . R. F. Cory of The Texas Co. described how two Cretaceous wells were successfully treated. Oil production declined so rapidly, however, that treating costs were not returned.

What is believed the largest formation fracturing job ever undertaken in California was described by G. V. Kersten, Western Gulf Oil Co. engineer. The 133-ft. perforated interval in a Fruitvale well was treated with 1,300 sacks of sand and 1,805 bbl. of crude.

The job was considered successful but not as good as hoped for. The company plans another job on the same well. A considerably coarser sand (8 to 12 size) was used. Also 4½-in. tubing will be needed to lower pressures and help speed up placement of the sand and crude.

Three Cycling Plants Planned

NEWCASTLE, Wyo.—Three more cycling plants, each to process 7,000,000 cu. ft. of natural gas daily, will be built in the Greater Clareton area of Wyoming.

The Marsh Co. of Tulsa, headed by Harry R. Marsh, has been retained by Tri-Co. Gas Co. to design and engineer the plants. Construction contracts will be let later. The Marsh Co. is completing installation of a 5,000,000 cu. ft. plant moved here from Sporn field near Cushing, Okla. It is expected to start operations around November 15. The plant will extract 20,000 gal. of liquids daily.

After liquids are removed, the dry gas will be reinjected into the producing formation at 1,600 psi. Core Laboratories, Inc., which is winding up a study of the field, will design the injection and pressure-maintenance systems and supervise the recycling operation.

All natural gas now produced in Clareton is being flared for lack of processing facilities. Several wells with gas-oil ratios above 5,000:1 were ordered shut in by the Wyoming Oil and Gas Conservation Commission. The cycling plants will cut waste in the field and permit production of the shut-in wells.

G.P. Eyes Oil-Shale Land

GRAND JUNCTION, Colo.—General Petroleum Corp. is negotiating for a "large tract" of oil-shale land in the De Beque area of western Colorado.

Marion Dice, G.P. presidential assistant, declined to give the price or acreage involved, but the deal reportedly will run into "several million dollars." Dice said the firm wants to lease the oil-shale land with an option to buy. G.P. already has sizable holdings in the area.

The official emphasized that G.P. is not starting an immediate program of shale development. Reason for the purchase, he said, is to back up the firm's oil-shale experiments.

"It would be foolish to conduct a costly research program without having enough land back of you," he said. "We're looking 50 to 100 years away."

Union Oil Co. recently started building a multimillion-dollar oil-shale plant in the Grand Valley area of western Colorado.

Pipeline Sale Approved

CHEYENNE, Wyo.—Montana-Dakota Utilities Co. has received permission from the Wyoming Public Service Commission to purchase a 340-mile pipeline from Montana-Wyoming Gas Pipeline Co. for $8,000,000.

Montana-Dakota has leased the 12-in. line since it was constructed in 1949. It extends from Worland gas field in Washakie County, Wyoming, to Montana-Dakota's Cabin Creek compressor station near Baker, Mont., in Fallon County.

The property includes the pipeline, a compressor, a dehydration and sulfur-removal plant in Worland field, and two 880-hp. compressor units installed at the Worland station since the line was built.

Montana-Dakota will issue 241,577 shares of common stock to Montana-Wyoming on a one for one basis. The buyer will assume outstanding first-mortgage bonds of Montana-Wyoming totaling $4,875,000 due June 1, 1970.

Industry Briefs

HOUSTON. — John W. Mecom, Houston independent oil operator, has purchased more than 250,000 acres of producing and nonproducing oil and gas properties in southern Louisiana from Mr. and Mrs. H. J. Lutcher Stark, Orange, Tex. The transaction reportedly involved $15,000,000.

NEW YORK. — Cities Service Co. plans to build a new products research center on an 100-acre tract adjoining the New Jersey Turnpike in Cranbury, N. J. Facilities will accommodate 150 scientists and technicians. Research emphasis will be on new product development in fuels and lubricants. But facilities also will be installed to study use of nuclear energy and radioactive-tracer techniques in improving petroleum products. Work on the center will start next month. Completion is scheduled in 1956.

HOUSTON.—Trunkline Gas Co. is nearing completion of an $18,000,000 expansion project on its natural-gas pipeline between South Texas and Illinois. The construction program, including eight new compressor stations, will permit the company to increase its deliveries by 80,000,000 cu. ft. per day this winter. The line joins Panhandle Eastern Pipe Line Co.'s system near Tuscola, Ill.

BATON ROUGE.—The State Mineral Board of Louisiana will accept bids for oil and gas leases on offshore tracts January 18, 1956. Nominations of blocks to be offered at this sale must be submitted no later than Monday, October 24, according to C. J. Bonnecarrere, board secretary.

CORPUS CHRISTI.—La Gloria Oil & Gas Corp. has started a long-range program to expand its oil and gas holdings through purchase of three Houston firms. A $412,000 deal announced last week by John Lynch, president of La Gloria, involved royalty interests in Texas, Louisiana, Arkansas, and Montana. Firms whose assets were acquired by La Gloria are Sandrock Royalty Co., Redrock Royalty Co., and Sabine Production Co.

HOUSTON.—Texas Gas Corp. has taken over the assets of a subsidiary, New Ulm Corp., and the latter firm will be dissolved. Principal properties held by New Ulm are in Austin County, Texas, where it operated about 26 oil and gas wells. Texas Gas Pipe Line Corp., another subsidiary of Texas Gas, will continue to operate in interstate transmission of natural gas.

Business learns from science . . .

. . . Operations Research Cuts Guesswork

F. Lawrence Resen

GALVESTON, Tex.—The scientific method that has made the modern processing plant a triumph of engineering achievement is catching on in the business side of operations.

It is replacing the rule of thumb and educated guess as the basis for decisions. The method can tell a refiner whether he should add a new still, or how many pumps he should keep in stock. It can help to determine whether he will be able to meet the heating-oil demand this winter, or if he has reached the optimum in blending gasolines.

This new technique is called Operations Research. It was aired thoroughly in a symposium at the tenth annual technical meeting of the South Texas Section of A.I.Ch.E. As explained by John Magee, of Arthur D. Little, Inc., Cambridge, Mass., O. R. means applying the scientific method to the study of operations of large complex organizations or activities.

Magee said Operations Research proceeds on the theory that business operations follow fairly well-defined patterns. O. R. is concerned not with individual parts of the organization, but rather with the combination of men, equipment, and technology at work toward an economic goal.

The idea is that the application of statistics and probability studies will remove much of the guesswork from basic decisions and offer new profit insurance.

How it works . . . Here's how Humble Oil & Refining Co. put O. R. to work at its Baytown refinery.

Two projects were launched to evaluate the method:

. . . Defining the best ratio of catalytic cracking to crude distillation capacity, taking into consideration the proper seasonal storage of gasoline and heating oil.

. . . Defining optimum oil storage capacity and related operations.

The oil-storage project is not complete, but both were described in papers prepared by O. R. Hamilton and T. J. Greaney of Humble.

The desired cracking-distillation ratio was found as a function of many variables. It depended on heating-oil price and gasoline demand, taking into account heating oil and gasoline seasonal storage, average annual heating-oil sales, and summer and winter crude charge relationships.

The optimum was computed for all variables. Seasonal gasoline and heating-oil demands were assumed to be variable from season to season. These variables were functions of winter severity and general business activity. The studies also evaluated differences in seasonal transportation costs and storage costs on products stored seasonally.

The result, Hamilton said, was to define the best possible decision in the face of uncertain product requirements. And management gave its stamp of approval by using the results to decide what to do about crude distillation and cracking capacities.

Other problems . . . Humble feels the method can be applied to many refining problems. Hamilton suggests two categories, one involving complex but well-defined problems not yet solved completely. Some of these problems:

. . . Optimum blending of motor gasoline and avgas components.

. . . Best possible operation of complex processes. This means optimalizing of four or more variables such as product requirements, feed availability, or operating conditions.

. . . Establishing most efficient distribution of mechanical craftsmen and scheduling of mechanical work.

. . . Study of material storehouse and oil inventories. The second category mentioned by Hamilton involves poorly defined problems whose solutions can be improved. Two of these are:

. . . An optimum research program—probability of success for specific projects, economic reward, limitations on equipment, and manpower availability.

. . . How to distribute technical services effort among short-range and long-range problems and trouble shooting.

Technical training . . . Hamilton points out two possible courses in adopting O. R.: Either train your own personnel in the technique, or bring in consultants. Humble prefers to teach O. R. to refiners rather than teach refining to O. R. specialists.

This preference is supported by W. M. Carlson, of the DuPont Co., Wilmington, Del. Operations Research works best when mathematics is the common language of communication.

O. R. is still in the trial stage in industry, Carlson said, and will remain so for some time. DuPont is using it to some extent and expects to profit from its adoption.

But there are many pitfalls. First, of course, the results must be sold to policy makers. The project can fail if it is turned over to an outsider without inside supervision; when the man who pays for the study can't define the problem or identify the basis for decisions; when management withholds information on the business; when a study report flashes with mathematical brilliance but ignores the profit angle; when cost data or other records are averaged out rather than reflecting effects of increased production and sales; or the project can fail when a study group tries to usurp decision-making power of the company under study.

Automation and Operations Research . . . Where does Operations Research come into the automation picture?

The fine line between the two was discussed by A. F. Sperry of Panellit Corp., Skokie, Ill. Automation is concerned with analysis, organization, and control techniques for optimum production processes.

O. R. takes in analysis and organization. Automation is a control function. But each is tied to the other. For O. R. results will be converted into day-by-day operations by automation.

Sperry said that control of operations is the main thing, but the emphasis is not necessarily on automatic control. With direct labor costs down to 3 or 4 per cent of product value in most modern refineries, he said other savings are needed to bring increased productivity.

He discounted the view that, because of the narrow margin left in labor saving, automation has reached a point of diminishing return in the processing industry. Sperry said the returns from better yields and conversions of raw material into products will far outweigh those from reduced labor costs.

One fertile field for improvement is cutting the amount to off-specification products produced.

The key to optimum processing is feedback control, or closed loop operation. Without it the operator doesn't learn when something goes wrong in time to do anything about it.

The ultimate in Operations Research or automation, Sperry concludes, is application of results to closed loop operations day-by-day. This can be achieved through combinations of centralized information centers, data logging, special purpose computers, and similar automation devices.

T.G.T. Plan Opposed

Coal, rail, labor groups fight gas import-export

WASHINGTON. — Coal operators, railroads, and labor groups have joined to fight plans of Tennessee Gas Transmission Co. and its newly-formed Midwestern Gas Transmission Co. affiliate to import Canadian gas.

The group is equally opposed to exporting U. S. gas to Canada at Niagara Falls, N. Y. It charges this is "merely another attempt to have Americans subsidize the all-Canadian natural-gas pipeline."

The new alliance will wage its fight before the Federal Power Commission. T.G.T. has filed its plans there with an application for the necessary permits to build an 1,112-mile pipeline and import and export the gas *(The Oil and Gas Journal, October 17, page 90)*.

A spokesman for the group said "large powerful competing" pipeline interests whose markets are threatened also will oppose the plan.

Tom Pickett, executive vice president of the National Coal Association, derided the idea of exporting gas. He said the life index of our reserves is below 22½ years' supply and industry leaders warn that new commitments to interstate carriers are falling off, fewer gas wells are being drilled, and funds for gas development are drying up—all as a result of the Phillips decision giving the FPC authority over independent producers.

Pickett asked: "What possible justification is there for heavy capital investment in a pipeline to Canada to serve areas already adequately fueled, depending upon the uncertain future source of supply from the Alberta fields through the nonexistent Trans-Canada pipeline and in the face of the rapidly diminishing reserves index?"

The T.G.T. proposal will spark a new drive in Congress for a law controlling the import or export of natural gas. Controls are proposed where the result would be economic dislocation, unemployment or injury to any segment of competing domestic fuel industries, Robert E. L. Hall, counsel for the association, predicted. Such a bill, written by the late Sen. Lester A. Hunt of Wyoming, was the subject of hearings last year before the Senate interstate commerce committee.

Colorado Line Under Way

GRAND JUNCTION, Colo.—Construction is under way on a 43-mile pipeline to transport natural gas from General Petroleum Corp.'s field in Rio Blanco County, Colorado, to the Pacific Northwest Pipeline Co. system.

The line will run southeast from Rangely, in western Colorado, to the Piceance Creek field where G.P. has several shut-in wells.

R. H. Fulton & Co., Lubbock, Tex., contractor on the Moab-to-Jensen, Utah, section of the Pacific Northwest line, also is building the 43-mile loop and a 16-mile gathering system. It is expected to be in operation by next July.

Voss Reacquires Production

NEWCASTLE, Wyo.—Voss Oil Co. has reacquired producing properties in Weston County, Wyoming, which were turned over to Buckhorn Production Co. for development in December 1953.

Buckhorn, owned by the Clint W. Murchison interests of Dallas, spent $5,150,000 in adding 58 consecutive producers to the 20 already drilled on the properties. The company has been repaid $1,740,000.

Under the original agreement, Buckhorn was to keep 90 per cent of the net from oil sales until all development costs had been repaid. Voss Oil then could regain control with Buckhorn retaining 5 per cent working interest in the properties. Negotiations just completed, however, give Voss full control. Settlement to Buckhorn was not disclosed. Controlling interest in Voss Oil is held by John R. Lewis, Inc., of Seattle, Wash., and associates.

Chalk Storage for L.P.G.

TULSA.—The first chalk cavity for L.P.G. storage is being mined by Tuloma Gas Products Co. and Sinclair Oil & Gas Co. in Alabama.

The project is on the Southern Railroad near Demopolis, Ala. Storage capacity will be 8,500,000 gal. Fenix & Scisson, Inc., Tulsa, is general contractor.

The firm will sink a 300-ft. shaft and set 42-in. casing. Storage tunnels will be mined laterally from the bottom. Fenix & Scisson expects to remove 50,000 cu. yd. of Selma chalk before the cavity is ready for use next May. Tuloma will operate the jointly owned project. No treatment of the chalk will be necessary.

New L.P.G. Barge Launched by Warren

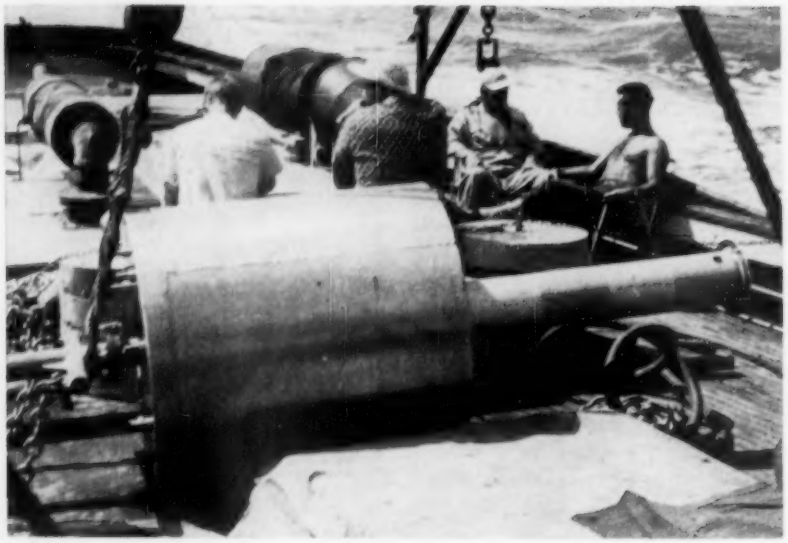
BEAUMONT. — A 550,000-gal. L.P.G. barge was launched here recently by Warren Petroleum Corp. —the sixth in its growing fleet.

The "City of Pensacola" is the third 550,000-gal. capacity barge built by Warren. They are capable of either inland water or ocean travel. In addition to the three big barges, Warren owns three smaller barges, two of 360,000-gal. capacity and one of 393,000-gal. capacity. A seventh barge is scheduled to be completed in early January. It will have a capacity of 400,000 gal.

Warren's fleet also includes a 33,000-bbl. tanker. It also is used for L.P.G. transportation.

The new barge, built at Bethlehem Shipyards here, is 245 ft. long and 48 ft. wide. It cost approximately $600,000. After the launching, it was towed to Houston, where it was filled for its maiden voyage.

Mrs. James E. Allison, wife of Warren's president, christened the barge.



Shell's Seagoing Surveyors . . .

. . . Stake Gulf's Farthest Well

HOUSTON.—Shell Oil Co. has "staked" location for a well 63 miles from shore. This is more than 20 miles farther at sea than any previous well.

Staking location was a tough job even for the seagoing surveyors and a strange ritual indeed for the landlubber oil man. The surveying crew sailed from Galveston in an 85-ft. boat. It was loaded with electronic equipment which spotted the location (top, above).

When the well site was located, the crew set out two buoys. A small styrofoam buoy was left to mark site for the actual drilling platform (left photo).

A permanent buoy (right photo) is placed 1,000 ft. from the well site to serve as a guide in future surveys. A light at the top is visible for 3 miles and is designed to burn 200 days continuously.

Plans call for spudding the test in December. It will be drilled in Block A-104, High Island area, southeast of Galveston. Location is in 93 ft. of water.

The problem . . . "Staking" the location presented an unusual problem. Because of the distance from land, normal surveying procedures were abandoned. Instead, elaborate electronic equipment was used to spot the buoys marking site of the proposed well.

Lorac Service Corp. was employed to survey. Its technicians pin pointed the location by checking radio beams.

In drilling the well, Shell plans to use "Mr. Gus," the $3,500,000 mobile drilling platform owned by Glasscock Drilling Co., Corpus Christi. This platform previously has been used in water about 85 ft. deep. Because of the increased water depth at the Shell location, 60-ft. extensions will be added to the 12 pilings supporting the giant platform. Plans also call for larger ballast tanks on each side of the platform to increase its stability.

Drilling block . . . The Shell test will be in one of 18 tracts off Texas which the company leased from the federal Government last July. These tracts, covering 103,680 acres, comprise the largest block ever leased by one company in the Texas or Louisiana tidelands. They range from about 50 to 65 miles from the coast and underlie water 80 to 100 ft. deep *(The Oil and Gas Journal, September 19, page 85)*.

Block A-104, selected for Shell's first test in the federally owned tidelands off Texas, is the most expensive of the 18 tracts. Shell paid a bonus of $1,019,520 or $177 an acre for the 5,760-acre tract.

Tentative projected depth of the well is 12,000 ft.

Block A-104 lies southeast of Galveston County, nearest point on the mainland. Farthest from shore of any well previously spudded is the Phillips Petroleum Co. test 40 miles off Louisiana *(The Oil and Gas Journal, August 8, page 69)*. Phillips is using a stationary platform at that location.

A.P.I. Creates New Division

NEW YORK.—The American Petroleum Institute last week created a new Division of Finance and Accounting.

A.P.I. President Frank Porter said the new division will replace the financial and accounting committee, in existence for 30 years. A vice president for the new unit will be appointed by the Institute's board chairman.

Porter said the change recognizes the rapid progress in corporate financing and accounting within the oil industry and gives these functions more emphasis.

Recommendation for division status came from the financial and accounting committtee itself, currently headed by P. C. Salman, of Socony Mobil Oil Co., Inc., New York.

Race to Continue

Octane trend will continue upward, chemists are told

GALVESTON.—Engines with more than 350 hp. and compression ratios as high as 11:1 may be powering U. S. autos in just 5 years.

But gasolines with an octane rating of 100 or higher will keep pace with the new demands, D. R. Diggs, of the Du Pont petroleum laboratory, told the tenth annual meeting of the American Institute of Chemical Engineers here.

By 1960, Diggs predicted, premium-gasoline ratings will average 98.8—and may be even higher in the East and Gulf Coast areas.

Harmful combustion chamber deposits will continue to be a major problem, Diggs said. But he explained that care in selecting hydrocarbon components of gasoline will cut down surface ignition and increasing octane requirements caused by deposits.

Commenting on immediate prospects, Diggs said fuel injection may appear in some cars "within a year or two." He said the injection system will mean more power, lower octane requirements, and freedom from vapor lock and carburetor icing—all advantages over carburetion as a method of fuel supply.

He added, however, that fuel-injection use within the next 5 years will be too slight "to affect refinery operations significantly."

Although gas turbines for cars and trucks are under extensive study, Diggs indicated their widespread use is even more distant. He said it will be "10 to 25 years at least" before the refiner will begin to feel the impact of this development.

Shell Rig Accident Free

LOS ANGELES.—Shell Oil Co. has given special recognition to 22 crew members of its Drilling Rig No. 5 for completing 6 years continuous operation without a lost-time accident.

Paul E. Lehr, manager of Shell's Los Angeles basin production division, said crews on the rig have amassed more than a quarter-million safe man hours in the Brea oil fields since November 30, 1949. He said a national drilling safety record of 7 years was set 3 years ago in Louisiana. A Phillips Petroleum Co. rig recently passed 6½ years without a lost-time accident *(The Oil and Gas Journal, August 22, page 100)*.

Shell entertained its drilling crew members at a barbecue in Brea commemorating their safety record.

WATCHING WASHINGTON

Bertram F. Linz

Security From Canada

Canadian officials do not expect any drastic limitations will be imposed on the import of Canadian oil into the United States.

The basic objective of the U. S. Government, to insure an adequate supply of oil from Western Hemisphere sources that could not be cut off in the event of war, hinges in part on development of Canadian reserves.

For this reason, Ambassador A. D. P. Heeney said last week, Canada does not believe that reasonable use of Canadian oil in both countries is other than a support to our common security.

Intensive development of Canadian oil has been made possible largely by the inflow of U. S. capital. Heeney pointed out that nearly 60 per cent of the industry is owned by nonresidents. That money has made it possible to use Canadian capital for other development.

This U. S. participation in oil development and equally important investments in other industries are being studied by a royal commission trying to chart Canada's economic future. The commission is attempting to draw broad conclusions about the direction and nature of Canadian developments over the next few decades.

Oil to Be Political Issue

There is no longer any doubt that oil will be a major issue in the 1956 presidential campaign.

That question has been settled by the Democratic Digest. The official organ of the Democratic National Committee has launched a vigorous attack on Interior Secretary Douglas McKay, for whose resignation, it says, is "a growing clamor."

The Digest spells out a long list of administration crimes in the area of natural resources and public power.

It cites the halting of synthetic liquid-fuels experiments with coal at Louisiana, Mo., and shale at Rifle, Colo., as horrible examples of how private enterprise, which pays a large part of the Government's cost, is being given a chance to get into new fields from which the Government later will collect more taxes.

The commercialization of synthetic fuels and the proposal to transfer the Government's helium monopoly to private ownership are seen as "bonanzas" for oil industry.

Labor Eyes Automation

There's been a lot in the news lately about automation. A joint congressional committee is trying to find out if it will make or take jobs.

Automation is old stuff in the oil industry. It shows up mostly as automatic or remote control of equipment. But it is reaching new heights in the automobile industry, where machines take over a hunk of iron and turn out a finished engine block.

Labor leaders generally do not see any unemployment resulting from automation. But they are determined it shall not be used to reduce workers' earning power. They are expected to make it clear before the congressional group that labor will expect increased benefits to compensate for the increase in automatic machinery.

It is not expected that automation in the oil industry will be an issue in the investigation.

Refiners Still Expanding

The oil industry is off to a fast start to provide the additional refining capacity called for in the administration's revised expansion program.

Applications for accelerated tax amortization of $50,000,000 worth of new facilities have been filed with the Office of Defense Mobilization since filings were resumed at the end of September. More than $100,000,000 worth of new refining facilities, pipelines, and tankers has been approved for quick write-off so far this month.

The largest application pending is apparently the result of the recent fire at the Whiting plant of Standard Oil Co. (Ind.). The company is asking for tax relief on facilities to cost $26,409,000 to replace and supplement the damaged equipment.

Other applications are not as big, but still are sizable. One from Esso Standard Oil Co. is in excess of $11,000,000. Another, from Gulf Oil Corp., is over $3,000,000. Pontiac Refining Corp. and Bankline Oil Co. have projects running close to $2,000,000 each.

Corrosion Costs Soar

Gulf offshore operators spending $2.5 million for painting alone; they now turn to better platform design to cut loss

Ed McGhee

HOUSTON.—The fight against corrosion of offshore platforms is forcing Gulf Coast operators to pay out some $2,500,000 annually for painting alone. Add to this corrosion-resistant alloys and costs of cathodic protection. And the total bill to fight corrosion is much greater still.

Operators, as a result, are developing some very definite ideas on the design for platforms. They must be designed not only to carry the load but also to be easy to protect.

There are three ways to make platform designs better, according to Daniel B. Stauffer of Humble Oil & Refining Co., Houston. In addressing the south-central regional meeting of the National Association of Corrosion Engineers, Stauffer grouped the improved methods this way:

. . . **Reduce surface area** in all parts of the structure.

. . . **Eliminate hard-to-coat** areas.

. . . **Protect both the coatings and the platform** itself from mechanical damage, such as caused by boats in heavy seas.

Three problems . . . In carrying out these ideas, said Stauffer, the designer has three separate corrosion problems in the three zones of the platform. First, and far hardest to protect, is the splash zone from minus 2 ft. to plus 6 ft. from mean gulf level. Second and relatively simple to protect, is the submerged area. Third, is the superstructure above the splash zone.

Stauffer reported most operators think their best bet to protect the splash zone is welded monel sheathing at $5 per sq. ft. This initial cost, although seemingly high, is not so serious as the likelihood of damage by boats close to the waterline.

On the superstructure, coating costs run as high as 50 cents per sq. ft. originally. Maintenance painting will range from 10 to 20 cents annually per sq. ft.

Fortunately, cathodic protection of the submerged zone is cheap and effective. According to Stauffer, magnesium anode systems cost only 5 cents or less per sq. ft. of bare steel per year.

What to do . . . Of course, reducing surface area in any zone of an offshore platform will cut cost of initial and maintenance protection. However, Stauffer pointed out cost can be further reduced by moving structural members from the splash zone and lower superstructure into the submerged zone and upper superstructure. Protection is easier and cheaper there. Moreover, deck sections should be reduced by good structural design, by boxing in structural members, and by removing unnecessary steel after drilling is over.

One method of reducing hard-to-coat areas is to use tubular members instead of structural shapes. Stauffer also recommended avoiding fabrication and water-phase erection joints. He suggested seal welding and boxing, and use of concrete to keep costs down.

In that critical splash zone, Stauffer emphasized the importance of good fender systems and good landing, loading, and mooring equipment.

Two Honored by A.G.A.

LOS ANGELES.—Two gas-industry executives were honored for outstanding service at the American Gas Association's thirty-seventh annual convention here last week.

Frederic A. Hough, Bechtel Corp., San Francisco, received the association's Distinguished Service Award for his efforts to limit government regulation and revise safety codes for gas transmission and distribution. Hough is former vice president of Southern Counties Gas Co., Los Angeles.

The Beal Award, one of the highest honors in the industry, went to Edward G. Boyer, manager of the gas department of Philadelphia Electric Co. It was the third time Boyer had won the award, presented for the outstanding technical paper submitted during the past year.

Rate Hikes Made Permanent

WASHINGTON.—Increases in freight rates on oil and gas industry supplies and equipment have been made a permanent part of the railroad-rate structure. The Interstate Commerce Commission granted them on a temporary basis in 1951 and 1952.

The increases applied to most traffic handled by the carriers and averaged 15 per cent. They were due to expire next December 31. But the ICC last week canceled the expiration date. In addition, it directed that the increased rates are no longer to be shown as surcharges. They now shall be a part of the published tariffs.

A petition to make the rates permanent was filed with the ICC by the major railroads last summer. The carriers said that operating costs have increased in the past 4 years to such an extent that higher charges are necessary. A number of industries, including coal, sought to have the commission reduce or wipe out increases on various commodities. Their pleas were denied.

Gas Storage Booms

Rising costs, big demand on peak days sparking growth

LOS ANGELES.—Increased gas demand and higher transmission costs are sparking the tremendous growth in underground storage operations of gas utilities.

A major factor also is the growing distances between producing areas and big consuming markets.

C. E. Loomis of Columbia Gas System Corp. stressed these facts last week in an address at the annual meeting here of American Gas Association. He pointed out it is five times cheaper to store gas underground for peak period use than to build pipelines big enough to meet the same peak demand direct from producing areas.

Loomis cited his company's plans as an example. It anticipates that February 1 will be the peak day of the 1955-56 winter. Columbia is prepared to deliver about 50 per cent of that day's requirements from underground storage. These facilities represent an investment of about $100 million.

But it would have cost $500 million to provide pipeline transmission for the same amount of peak day gas. Further, he said, the low load factor in such a big pipeline operation would greatly increase cost of gas to consumers.

It now takes 6 times more gas to meet demand on the peak winter day than it does on July 1, the minimum day, Loomis explained. Solving this great differential has given underground storage its import role in gas utility operations.

Recent A.G.A. storage committee statistics list 40 companies operating 172 underground storage reservoirs. These can store 1,859,000 M.c.f. *(The Oil and Gas Journal, May 16, page 118).* The storage fields contain 6,400 wells and 116 compressor stations with over 100,000 horsepower ratings. The maximum amount of gas stored 1 year ago slightly exceeded 1 trillion cubic feet. These facilities represent an investment of $340 million.

Expansion Endorsed

Humble shareholders vote more stock, new charter

HOUSTON.—Humble Oil & Refining Co. stockholders last week authorized the firm to expand into new fields and possibly acquire holdings from other companies.

At a special meeting here, shareholders voted an increase from 36,000,000 to 38,000,000 shares. They also amended the company's articles of incorporation under terms of the new Texas Business Corporation Act. This law permits a firm to expand its operations.

A proxy statement explained that the 2,000,000 additional shares would be available for use in Humble's business undertakings "such as the acquisition of desirable properties or securities of other corporations." Humble officials have stated, however, that the company has no immediate plans for the additional shares.

Hines H. Baker, president, explained in announcing the meeting several weeks ago that the proposed charter amendments would allow a greater latitude and flexibility in Humble's operations *(The Oil and Gas Journal, October 3, page 82)*.

The new articles of incorporation authorize the company to "acquire, produce, manufacture and market all sorts of chemicals" and to conduct fundamental and applied research. In addition to oil and gas, sulfur and other natural resources found in connection with petroleum operations now may be developed by the company. Humble has large sulfur reserves in submerged lands under the Gulf of Mexico.

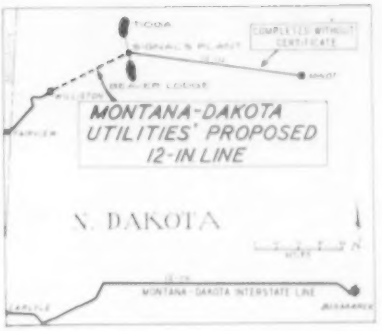
Official instrument changing the company's articles of incorporation has been filed with the secretary of state in Austin.

Refinery to Hike Capacity

SALT LAKE CITY.—Salt Lake Refining Co., a subsidiary of Standard Oil Co. of California, will increase the capacity of its 32,000-bbl. refinery here to 37,000 bbl. daily.

J. T. Higgins, president of the California Standard affiliate, said the expansion would tie-in with a 165-mile crude-oil line which the company is building from Rangely, Colo., to Salt Lake City. The 10-in. line is nearing completion.

Work on the refinery will start around the first of December and will be handled by refinery personnel.



Gas Line Approved

Tioga, Beaver Lodge fields finally will get an outlet

WASHINGTON. — Montana-Dakota Utilities Co. has received temporary authority from the Federal Power Commission for a 41-mile, 12-in. natural-gas pipeline from Williston to Tioga, N. D.

In granting the permit, the FPC noted it was issued "without prejudice to such final disposition of the application as the record may require."

Facilities will include 41.8 miles of 12-in. transmission main; 11,520 ft. of laterals; two gas-measurement stations; gas-distribution systems to supply several towns; and an emergency connection between the new line and an intrastate system now being tested.

The intrastate system is a 12-in. line from Tioga to Minot. Montana-Dakota already has built the line without certificate from the North Dakota Public Service Commission. Company officials describe it as "strictly a business risk venture."

Both of these lines would take residue gas from the Signal Oil & Gas Co. gasoline plant near Tioga. This plant processes gas produced in Tioga and Beaver Lodge oil fields. At present nearly 20,000,000 cu. ft. of residue gas daily is being flared. Amerada Petroleum Corp., which owns the dry gas, is using only about 3 to 4 million cubic feet daily in its field operations.

The Tioga-Williston line would add a new source of supply to Montana-Dakota's interstate pipeline system, which ends at Williston. It also would serve the towns of Ray, Wheelock, Epping, and Springfield, N. D., with initial natural-gas service. The Tioga-Minot section would serve 12 small North Dakota towns and some ranches.

Montana-Dakota earlier this year proposed a line from Tioga through Minot with branches serving Grand Forks and Fargo in the eastern section. The plan was canceled when it failed to firm up a supply of gas *(The Oil and Gas Journal, April 11, page 78)*.

Canadian Briefs

CALGARY. — Trans-Canada Pipe Lines, Ltd., plans to start building the Toronto-Montreal section of its proposed all-Canadian natural-gas line next spring. Trans-Canada has ordered 335 miles of 20 and 24-in. pipe costing $9,000,000. Tennessee Gas Transmission Co. has asked Federal Power Commission authority to export up to 90,000,000 cu. ft. daily of Gulf Coast gas for the Toronto-Montreal line.

LONDON.—Eagle Oil & Shipping Co., Ltd., a subsidiary of Canadian Eagle Co., has placed a $34,000,000 order for seven tankers at British shipyards. Three of the ships will be 18,000 tons deadweight and four will be 32,000 tons. The vessels will be turbine propelled and will be completed by 1959. The Royal Dutch-Shell Group has a large interest in Canadian Eagle.

EDMONTON.—Imperial Oil, Ltd. has completed its ultramodern, $13,000,000 lubricating-oil plant started here in July 1954. Alberta Premier E. C. Manning will preside at the formal opening November 2. The 2,000-bbl. daily plant, which has a Hydrofining unit, will turn out 41 types of lube oil. It is Canada's second largest lube-oil facility, ranking behind Imperial's 4,440-bbl. Sarnia plant.

QUEBEC.—Imperial Oil, Ltd., has completed an initial exploration program in Quebec and plans to drill one or two wildcats in 1956.

WINDSOR, Ont.—Consolidated West Petroleums, Ltd., Toronto, has extended production in its Lake Erie gas field. It has completed a step-out well 4 miles offshore. The well, No. 17, was completed with a daily potential of more than 2 million cubic feet daily. The Toronto company is developing the offshore field with cable-tool rigs *(The Oil and Gas Journal, July 11, page 94)*.

CALGARY.—Stockholders of both firms have approved purchase by Amurex Oil Co. of the assets of Ponder Oils, Ltd. Amurex issued 650,000 shares to Ponder. In return it received the working assets and stock of Ponder's subsidiaries, Devon Drilling Co. and Ponder Oils, Ltd.

TORONTO. — Surpass Petrochemicals, Ltd., is equipping a new plant at Scarborough, Ont., to make Canada's first petroleum sulfonates and synthetic sulfonates. Plant production will start early in 1956. Output will go primarily to the lubricating field.

Tax Relief Sought

Offshore operators fight transport levy on their boats; plant pipelines also suffer; Congress asked to clarify law

WASHINGTON. — Offshore oil operators are chafing under a transportation tax they say Congress never intended them to bear.

The levy is only 3 per cent. But applied to the fleets of small boats used to haul men and equipment between the mainland and offshore rigs, the tax runs into big money.

Representatives of the industry told their troubles to a House ways and means investigating subcommittee last week.

They declared the courts have held repeatedly that the tax does not apply on transportation so closely integrated with other operations as to be inseparable. But the Internal Revenue Service will not apply that theory to offshore operations.

Thousands of boats are being used in operations off the Gulf Coast and in the bayous of Louisiana and Texas. Only a few are owned by oil companies. The rest, while under the complete direction and control of the companies, are leased. The tax applies to these lease payments. The boats may be used only a few hours a day, but no allowance is made for standby time.

This is not transportation of the type Congress intended to tax, the subcommittee was told by Edward H. Schlaudt, attorney for The Texas Co. He was appearing for the Mid-Continent Oil and Gas Association.

There is no more "transportation" involved, he said, than there is when employes ride an elevator from one floor of a building to another or walk from office to office.

"When an entire operation is surrounded by water, the employes cannot walk," Schlaudt pointed out. "But certainly the employer should not be subjected to an excise tax on 'transportation' because he makes possible the necessary mobility of his employes by providing boats."

Cases in court . . . Several companies have been contesting the tax for more than 2 years. Their cases have reached the point where court action is the next step.

"The companies intend to litigate, and are preparing for costly, long drawnout court action if necessary," Schlaudt warned. "They do not intend to stop short of the highest possible court of appeal, if appeal is required.

"But litigation should be made unnecessary by a legislative amendment expressly exempting from the transportation taxes movements of this type," he added. And the amendment should be retroactive, so as to eliminate needless litigation over prior years' taxes, he said.

Pipelines hit, too . . . The industry also is fighting the tax as applied to pipelines which are part of the integrated operation of refineries, bulk plants, or terminals.

The 1942 revenue act attempted to clear up the situation with respect to the in-plant movement of oil by pipeline, exempting it where it is not a continuation of transportation subject to tax.

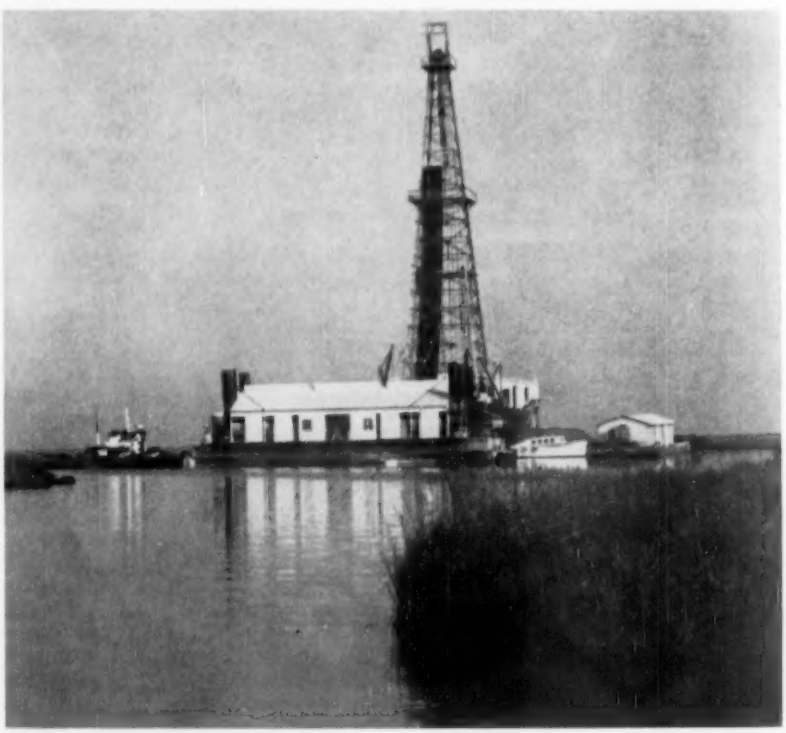
Despite this amendment there has been considerable litigation over efforts to tax movements to and from refineries, dock sites and tank farms. Herbert E. Foster of Sun Oil Co. pointed this out in appearing on behalf of the American Petroleum Institute.

In every case so far the courts have held in favor of the taxpayer, Foster said. But only a new amendment of the law will clear up the situation and make further suits unnecessary. The amendment should clearly state that the term "transportation" does not include movements by pipelines controlled by a refinery, bulk plant, or terminal as long as they are part of the over-all operation of the plant, he said.

Packard Ratio Hits 10:1

DETROIT.—Packard has announced its new 1956 models will have 10 to 1 compression ratios—the highest yet announced by the automobile industry.

Two engine models will produce 290 and 310 hp., both with the 10 to 1 ratio. Packard claims its higher torque engines will permit 20 per cent greater fuel economy. Last year's models had two engines, one at 8.25 to 1 making 225 hp. and the other 8.5 to 1 making 245 and 260 hp.



Near the Record and Still Going Deeper

This Richardson and Bass steam rig late last week had drilled to 20,934 ft. and was drilling ahead in hard sandstone. The hole, already Louisiana's deepest, was only 548 ft. from a new world's record. Even if it failed to set a new drilling record, encouraging shows up the hole have indicated it might become the world's deepest producer. The well is 35 miles southeast of New Orleans in the Mississippi Delta marshes of Plaquemines Parish. Associated with Richardson & Bass in the venture are John W. Mecom, Houston, and Freeport Sulphur Co., New Orleans.

Allowable Raised

Texas maintains 16-day schedule for next month

AUSTIN.—Texas crude producers will get an increased allowable in November for the third consecutive month.

The Texas Railroad Commission last week hiked the state allowable to 3,236,051 bbl. daily. This is 96,771 bbl. over the allowable in effect October 1 and 86,592 bbl. over the initial figure set for October.

The state will remain on a 16-producing-day schedule. The increase results from the fact that there are only 30 days in November against 31 in October.

Most purchasers asked for a 15-day schedule, expressing concern over the current high level of product stocks.

The commissioners, in deciding on 16 days, pointed out that both crude and product stocks are below year-ago levels. Commissioner Thompson called attention to statistics showing crude stocks are about 10,000,000 bbl. below levels declared adequate by the industry for this time of year.

Ralph Dietler, of Stanolind Oil Purchasing Co., informed the commission that his firm has resumed full-scale crude purchasing. The company reduced its buying immediately after the explosion and fire in the Whiting, Ind., refinery of Standard Oil Co. (Ind.).

Lease Sale Disappointing

BATON ROUGE.—The Louisiana Mineral Board last week accepted bonuses totaling $772,638 for oil and gas leases which had been expected to bring up to $3,000,000.

The board leased only 6,870 acres of nearly 22,000 offered. Bids totaling more than $200,000 were rejected and no offers were received on four offshore tracts.

Largest bid was $200,239 by Texas Gulf Producing Co. for 1,750 acres in Four League Bay. This was rejected, however, in favor of an offer by John W. Mecom and others of $116,785 for a 640-acre portion of the tract. The successful bid also included 17⅜ per cent royalty.

Petrofina Plant Testing

MONTREAL.—Canadian Petrofina, Ltd., will soon go on stream with its 20,000-bbl. daily refinery here processing various imported crudes.

The 16,600-bbl. daily Houdriflow cat cracker was making checkout runs last week, processing light and heavy gas oil from the vacuum distillation unit. Full-scale test runs of the complete integrated refinery will follow.

The plant, designed for maximum yields of high-octane gasoline, is the most modern of its type of the world, using five catalytic processes. A fluid coker is still under construction.

Gas Drillers Busy

Pacific Northwest sinking 12 wells per month in basin

DURANGO, Colo.—Pacific Northwest Pipeline Co. is drilling wells at the rate of 12 a month in the San Juan basin of Colorado and New Mexico. This area is principal source of natural gas for its $160 million, 1,455-mile line to the U. S. Northwest.

The firm plans to drill 1,000 gas wells in the basin over a 10-year period. With 7,700 acres of Ute Indian land acquired at a tribal sale last week, the company now has locations for 1,047 wells.

James M. Clark, Albuquerque, N. M., vice president in charge of production, said Pacific Northwest is increasing its deliverable gas at a rate of half a million cubic feet a day. This is the result of its drilling program in the Bondad and Ignacio, Colo., and Gubernador, N. M., areas.

Pacific Northwest already had 80 million cubic feet of gas available from 89 wells it took over from Stanolind Oil & Gas Co. and from 33 wells drilled since.

"We'll have more gas than we need by the time the line is open," Clark said.

The company is scheduled to start drawing San Juan basin gas about July 1956. It is required to deliver 293 million cubic feet a day starting January 1, 1957.

Imports Reach All-Time Peak

CRUDE imports set an all-time record in August averaging 845,000 bbl. daily, according to tabulations of the U. S. Census Bureau.

However, a part of the record total may represent late tabulations of crude that actually came in during July. The Census Bureau report for July showed an average of 801,000 bbl. daily for that month compared with 832,000 bbl. daily shown by company reports to the Bureau of Mines.

Based on the Census Bureau reports, new records were set in August for Canada and Iraq. Crude from Canada has set new records in each of the past 6 months, as more crude was brought in for new refineries in Minnesota and the Pacific Northwest. Canada now ranks fourth as a supplier of foreign crude for U. S. refineries, topped only by Venezuela, Kuwait, and Saudi Arabia.

A breakdown of crude imports by receiving districts shows 20,618,000 bbl. for East Coast, 1,413,000 bbl. for Gulf Coast, 2,560,000 bbl. for California, 1,068,000 bbl. for Pacific Northwest, and 526,000 bbl. for Great Lakes districts.

Product imports averaged 400,000 bbl. daily in August, the highest average since May and about 30,000 bbl. daily above the peak month for the summer of 1954. All of the August gain was in receipts of heavy fuel.

Crude and product exports averaged 360,000 bbl. daily for the highest monthly average since June 1953. The August average was 24,000 bbl. daily above July and 73,000 bbl. daily greater than for August 1954. Most of the gain over last year was due to increased shipments of distillate and residual fuels.

IMPORTS INTO CONTINENTAL U. S.
(Thousands of barrels)

	Aug. 1955	July 1955	Aug. 1954
Crude—			
Mexico	425	752	404
Colombia	616	490	1,030
Venezuela	13,118	11,452	10,955
Peru		123	
Ecuador	71	122	
Trinidad			115
Kuwait	4,191	4,657	3,889
Saudi Arabia	2,577	2,677	2,759
Neutral Zone	333		
Iraq	1,131	565	283
Iran	208	895	
Qatar	620	586	337
Canada	1,593	1,343	105
Far East	1,302	1,179	996
Total crude	26,185	28,841	20,873
Daily average	845	801	673
Products—			
Residual fuel	10,907	7,390	7,399
Other products	1,497	1,769	1,779
Total products	12,404	9,159	9,178
Daily average	400	296	296
Total all oils	38,589	34,000	30,051
Daily average	1,245	1,097	969

EXPORTS*

	Aug. 1955	July 1955	Aug. 1954
Crude	1,191	887	1,349
Gasoline	2,481	2,591	2,253
Kerosine	295	429	77
Distillate fuel	2,170	2,229	1,412
Residual fuel	2,656	1,872	1,596
Lube oils	1,227	1,297	1,347
Other products	1,141	1,106	849
Total all oils	11,161	10,411	8,883
Daily average	360	336	287

*Excludes shipments to territories.

Curb on imports to be delayed as . . .

. . . New Approach Sought

WASHINGTON.—Don't look for the Government to put quotas on imports in the near future.

It was hinted in government circles last week that a new approach to the imports problem will be sought. To get a new view, another cabinet study may be called for.

A new study, it was said, could give weight to developments not foreseen when the cabinet report was issued last February.

Total imports for 1955 now are seen as averaging 112,000 bbl. daily above the recommended level. The excess will run to 79,000 bbl. in crude and 33,000 bbl. in products, according to figures given the Independent Petroleum Association of America last week by Russell B. Brown, general counsel.

The problems . . . The big increase in crude imports is due to two factors:

. . . Location of new refineries along our northern boundary in Minnesota and the Pacific Northwest. These are dependent upon Canadian crude.

. . . The heavier volume sold by major importers to others who bring it in.

The proper treatment of Canadian oil and independent importers are only two of many questions which make quotas hard to work out. But officials contend there is nothing in the Reciprocal Trade Act to force the Government to deal with the situation only by quotas.

Current thinking in at least some influential government circles appears to run like this: Although the Senate finance committee indicated it had the cabinet recommendations in mind, the trade act amendment it wrote does not refer to them but only to imports which threaten the national security.

The building of refineries near the Canadian border is in line with the Government's security policy of encouraging the dispersal of vital industries, they say. So, since these plants cannot economically get domestic oil, their imports are essential to the national security.

Brown's report . . . In his report to the I.P.A.A., Brown pointed out that if the major importing companies were to "move over" to make room for other importers they would have to cut their fourth-quarter crude imports by 25 per cent from the 474,000 bbl. daily they have indicated they will bring in, to be in line with the cabinet formula.

"Obviously," Brown said, "none of these five companies is taking the action necessary to accomplish this."

Brown reported that 1955 imports will average 18.3 per cent of domestic crude production. The formula calls for imports of 16.6 per cent, itself more than three times the prewar average of about 5 per cent.

New Company Formed

MIDLAND, Tex.—Texas American Oil Corp. has been formed here by local and eastern interests to explore for and develop oil and gas production.

Operations will center in the West Texas area.

President of the new firm is Nash J. Dowdle, who also is president of St. Anne's Oil Production Co., Midland. C. L. Milburn, owner of Navarro Royalty Co., is executive vice president, and J. H. Bartley, Midland consulting geologist, is vice president.

Directors besides Dowdle, Milburn, and Bartley include: D. C. Baldwin, Midland; Thomas F. O'Neil, New York, president of Mutual Broadcasting System; Peter Kelliher, Chicago, president of Killiher Co., Inc., of Kerry Corp., and chairman of the board of Prudential Management Co., Inc.; and John J. Dowdle III, New York, vice president of Great Lakes Carbon Corp.

French Forms Drilling Firm

MIDLAND.—Lloyd R. French, veteran contract-drilling and equipment-supply man, has formed a new drilling-contracting firm here, Lloyd R. French Co.

French resigned as an officer of Tri-State Drilling Co., Midland, and sold his stock in that firm when he decided to start the new company.

Production superintendent of Lloyd R. French Co. is Roy L. Franklin, who formerly was with Loffland Brothers and T & C Drilling Co.

The company operates two medium-sized rotaries—one capable of drilling to 6,500 ft., the other to 9,500 ft.

Prior to buying into Tri-Service Drilling, French organized French Tool & Supply Co. at Oklahoma City and operated that concern from 1936 to 1952.

Dry-Chemical Extinguisher Smothers Flames

One spurt from this new dry-chemical fire extinguisher controls a flaming gas well blowing at 3,800 psi.—that's the claim of L. J. Dugas Corp., Houston. It was unveiled before safety engineers at Shell Oil Co.'s Sheridan, Tex., recycling plant. Dugas, the inventor, is shown driving flames ahead of him across a 60 by 25 ft. pit containing 2,000 gal. of oil and 50 gal. of gasoline ignited for the demonstration. The 100-ft. flames were out in 30 seconds, Dugas said. An unidentified dry chemical in the form of a fine powder is blown over the flames. The heat causes a chemical reaction releasing an inert gas in an expansion ratio of more than 1,100 to 1, smothering the fire. The extinguisher is said to be easily adapted to an automatic system suitable for offshore drilling rigs.

Influence Probed

Oil agencies facing quiz as House hearings resume

WASHINGTON.—A House judiciary subcommittee is trying to measure the influence exerted by oil and other industries in shaping government policies.

The subcommittee, headed by Rep. Emanuel Celler of New York, resumes hearings this week. Objects of the inquiry are activities of industry advisory committees and businessmen working in the federal agencies without pay.

The study, however, may develop into a much broader probe of matters in which industry had a voice. Inquiries of several agencies by the subcommittee staff indicate that the military petroleum advisory board, the voluntary foreign supply agreements and possibly the Iranian consortium and even the import situation may be under examination.

The investigation started last session. It was dropped temporarily when Congress adjourned in August. At that time the business advisory council of the Commerce Department still was under study. That inquiry was stalled by refusal of Secretary Sinclair Weeks to open the BAC files to subcommittee scrutiny, but Celler said the matter would not be dropped.

Over the past 2 months Celler's staff has contacted various agencies, including the Office of Oil and Gas in the Interior Department, the Defense Department, the Justice Department, and Office of Defense Mobilization. The inquiries have asked details regarding advisory committees and the employment of experts and consultants on loan from industry.

Two requests for data on the National Petroleum Council and the employment of oil men in the Petroleum Administration for Defense and the Oil and Gas Division were sent the Interior Department.

Texaco, Union Sign Contract

PORT ARTHUR, Tex.—The Texas Co. has entered a new 1-year contract with Local 23 of the C.I.O. Oil, Chemical and Atomic Workers International Union, which represents approximately 5,000 employes in the Texaco refinery here.

Details of the new agreement were not revealed. Wages were not involved in the negotiations. Other workers in the same local have asked a general wage boost of 15 cents an hour at Gulf Oil Corp.'s refinery here *(The Oil and Gas Journal, October 24, page 94)*.

Low-gravity producers benefit as . . .

California Crude Prices Rise

SAN FRANCISCO.—Many California producers and refiners got an economic lift last week. Several majors increased their postings for heavy crude and residual fuel.

Standard Oil Co. of California made the first move. It posted an increase of 1 to 10 cents for crude of 26°-gravity or less. The lower grades got the higher boost. Tide Water Associated Oil Co. and Union Oil Co. made similar increases, all effective October 17.

The new field prices begin with a 10-cent raise for 14°-gravity crude and under, changing the price from $1.87 to $1.97 per barrel. The 19°-19.9°-gravity crude was raised 9 cents from $2.18 to $2.27. The scale goes down to a 6-cent raise from $2.45 to $2.51 per barrel for 23°-23.9°-gravity crude and to a 2-cent increase for 25°-25.9° gravity.

The full 10-cent increase will cover about 230,000 bbl. of California's current 976,000-bbl. daily production. The 6-cent raise will be applicable approximately to 260,000 bbl. Bulk of the remaining 486,000 bbl. output was not affected by the new prices.

Socal also announced a 15-cent per barrel increase in prices for heavy fuel oil and a 20-cent boost for distillate fuel oil. Union, Tide Water, Richfield Oil Corp., and General Petroleum Corp. joined in making the increases.

The improved price picture in California has been predicted for several weeks *(The Oil and Gas Journal, October 10, page 129)*. It reflects two developments: An increased demand for West Coast crude and reduction of large inventories of heavy fuels by shipments to the East Coast and Pacific.

It was the first general price increase for California crude since February 16, 1953. In that change of postings, the lighter crudes received the larger increase. This led to claims by producers of heavy crude that they were discriminated against. The current price changes met their objections, however, by boosting prices for the heavy ends.

Texas Standardizes Gulf Field Names

AUSTIN, Tex.—The Railroad Commission last week adopted a standardized system of naming new fields in the Gulf of Mexico off the Texas coast.

The system, worked out by the field naming committee of the Corpus Christi Geological Society, had been approved unanimously by companies engaged in offshore drilling.

Under the system, all new fields in the Gulf will incorporate in their names the uniform prefix "GOM" (Gulf of Mexico), and the designation and number of the state or federal tract in which the discovery well is located.

The three typical names follow:

GOM-ST-948 (Gulf of Mexico-Small Tract-948).

GOM-LT-840 (Gulf of Mexico-Large Tract-840).

GOM-FT-1054 (Gulf of Mexico-Federal Tract-1054).

Small state tracts, lying within a strip bordering the coastline and extending approximately 3 miles offshore, normally are 1 mile square, embracing 640 acres. Large state tracts, extending from this strip to outer limits of state jurisdiction, normally are 3 miles square with 5,760 acres. Federal tracts, in the outer Continental Shelf area, normally are the size of the large state tracts.

If more than one field is discovered in a tract, the directional suffix North, East, South or West will be affixed to the name after the tract number. If a field extends into tracts adjoining that in which the discovery well is located, the discovery well's field name would apply regardless of the tract number. Names of existing fields will not be changed to conform to the new system.

The new system will eliminate delays in naming fields and permit easy location of the field on the map. It supersedes the old system of tying names of new fields to some nondescript land feature.

Sinclair Has Utah Gasser

SALT LAKE CITY.—An important gas discovery has been completed in Grand County, eastern Utah, along the route of Pacific Northwest pipeline. It is Sinclair Oil & Gas Co. 1 Government-San Arroyo.

The well flowed 18,500 M.c.f. of gas daily on 1-in. choke from perforations in the Entrada at 4,851-4,923 and 4,929-93 ft. Location is 3 miles north of Bar-X Unit field, a Dakota gas-producing area. The Sinclair well reported the best gage yet for a Grand County gas discovery. The county is the most active area in Utah.

Waste Hearing Set

New producing regulations studied for Rangely field

DENVER.—The Colorado Oil and Gas Conservation Commission has withdrawn all rules and regulations governing production from the Weber reservoir of rich Rangely field in northwestern Colorado.

The commission scheduled a hearing October 25 to receive final testimony before issuing a permanent order to prevent the waste of oil and gas in the field. According to Deputy Commission Director Arthur Jersin, the operators have indicated they will maintain the status quo.

One of two orders withdrawn, issued in September, limited oil production to 275 bbl. per well per day and gas flaring to 30,000 cu. ft. daily from any one well.

Another order, issued in July and continued temporarily until October 14, endorsed an agreement proposed by The California Co. and some other operators. They felt the protection of a state order was needed to avoid possible conflict with federal antitrust laws.

The two orders were rescinded and the October meeting called, Jersin said, because the "operators were right down to the wire and wanted the commission to review one or two more points before a permanent order is issued."

Rangely field operators have been reinjecting gas voluntarily since September 15, 1953. The Colorado Supreme Court earlier this year voided a commission directive ordering reinjection of gas into the Weber reservoir. The court ruled the state agency exceeded the authority vested in it by the Colorado Legislature.

Firm Plans Switch to Gas

SPOKANE, Wash.—Spokane Gas & Fuel Co. plans an $8 million construction program next year. It will convert its distribution system to natural gas and prepare for an expected growth in its markets.

The company in the past has sold and distributed propane and manufactured gas. But it will switch to natural gas when Pacific Northwest Pipeline Co.'s new line is completed through this area.

Ray C. Fish is one of the owners of Spokane Gas and also board chairman of Pacific Northwest which is building a 1,466-mile natural-gas pipeline from the San Juan basin to Washington. It also will connect at the Canadian border with a new Westcoast Transmission Co. line to import Alberta gas.

Fish reported Spokane Gas originally planned to spend $5 million on its initial distribution expansion. This has been broadened, he said, to an $8 million outlay between February and November next year.

Utility Buys Coke

Esso sells 170 tons daily as fuel to generate power

NEWARK.—Public Service Electric & Gas Co. has contracted for the entire output of Esso Standard Oil Co.'s fluid coke production at Baltimore.

It will be the first commercial use of fluid coke for power generation.

About 170 tons per day will be moved to the utility's generating station where it will be burned in modern boilers to generate electricity. The coke will replace about 750 bbl. per day of heavy fuel oil. The contract was closed after successful burning tests were run on 1,000 tons of fluid coke supplied by Carter Oil Co.'s Billings, Mont., unit.

Conventional ball grinding mills, conveyors, and boilers were used in the test.

Esso has resumed operation of its 10,000 bbl. per day Baltimore coker following a shutdown September 23 to modify gas compressor and debutanizing units. New inhibitor facilities were installed to avoid fouling in the debutanizer feed system to prevent clogging. Additional flushing points were installed on the gas compressor to avoid accumulation of heavy material which had previously reduced its efficiency.

The unit is operating at 50 per cent of capacity and will now increase feed rates. The unit went on stream in early September.

San Juan Acreage Sold

SANTA FE.—Western Development Co. of Santa Fe has bought full interest in 7,680 acres in the West Kutz field of the San Juan basin in New Mexico. Western originally held only a half interest in the property.

Western is a producer of natural gas, lead, zinc, and other minerals. Its latest acquisition gives it control over a tract with 11 gas wells producing from the Pictured Cliff formation. It also contains 5,920 acres of undeveloped land.

To ease engineer shortage . . .

. . . Shell Will Aid Teachers

NEW YORK.—Shell Companies Foundation, Inc., is attacking the shortage of scientists and engineers at its root—in high school.

Shell will underwrite summer seminars at Cornell and Stanford for 60 outstanding teachers of physics, chemistry, and mathematics. They will receive campus living expenses, all tuition and fees, and travel allowances. They will get $500 in cash to offset any earnings loss during the seminars, lasting 6 weeks at Cornell and 8 weeks at Stanford.

The selected teachers will see how their subjects are applied in major industrial plants and research laboratories. They will hear lectures by top scientists and attend graduate-level classes.

Shell expects the program to pay off in:

. . . **Inspired and up-to-date** teachers.

. . . **Better science instruction** in high schools.

. . . **More bright students** being recruited for technical careers.

The plan underlines the trend among oil companies toward recognizing the high-school teacher as one key to solution of the technical manpower shortage *(The Oil and Gas Journal, October 17, page 102)*. There is already a demand backlog of some 30,000 engineers and scientists. This figure will mount as companies continue to fill only part of their needs from the short crops of graduates.

Shell calls its program the broadest yet advanced for science teachers, whose ranks have been depleted through hiring by industry and fewer graduates choosing education careers.

"We hope the merit fellowships will assist in focusing public attention on this critical shortage of science teachers and also induce others to do something similar," Shell announced.

Who is eligible . . . To be eligible for a seminar fellowship you must be:

. . . **A math, physics, or chemistry teacher** with 5 years' experience and known leadership ability.

. . . **Or a department head with teaching experience** and good background in one of those fields.

Thirty will be chosen from east of the Mississippi for the Cornell seminars, and 30 from the western part of the country to attend Stanford. It will be up to the colleges to decide who is chosen.

Shell already awards 50 graduate fellowships and 20 research grants in a $350,000 program to aid education.

Italy Favors Monopoly

But some improvements due for foreign companies too if nationalists don't block proposed amendments to oil law

Paul Swain

PROPOSED amendments to Italy's 1927 oil law are almost certain to safeguard the favored position of the government's oil company. But they are also likely to spell out what foreign companies can expect.

Reports from Rome last week indicated Premier Antonio Segni has a draft of the proposals he intends to present to the Italian Parliament next month. They are the result of a study of Western Hemisphere oil legislation made by two university professors at the premier's request.

Just how successful the premier's coalition regime will be in selling them to the Italian legislature is the question.

Unofficial sources in Italy say the new legal provisions will confirm the exclusive position of Ente Nazionale Idrocarburi, the state-controlled oil agency, in the Po Valley. The status of private companies in other parts of Italy will be defined, which would be a distinct improvement over present conditions.

What law may say . . . Single exploration permits reportedly will be limited to 50,000 hectares (123,500 acres) and exploitation concessions to 10,000 hectares (24,700 acres). No company or individual would be allowed more than six such exploration areas, or a total of 300,000 hectares (741,000 acres), or eight exploitation concessions with a total of 80,000 hectares, (197,600 acres).

These acreage limitations are stringent when compared with the oil legislation in some other countries of the world. Petrosud, S. A. (Gulf-Montecatini) now has three blocks of 247,000 acres each in the Abruzzi Mountain area of Italy's Adriatic coast.

Petrosud has made the only significant oil strike on the Italian mainland, but its two wells are still shut-in because the government has not granted the company an exploitation concession.

Turkey's new oil legislation is more liberal with respect to acreage. It has the same 50,000-hectare limit for single exploration areas, but allows a company to have eight of these or a total of 400,000 hectares.

Exploitation concessions in Turkey are 25,000 hectares (61,800 acres), or 2½ times the size of those proposed for Italy. Again, an operator may have eight of these.

Background . . . The question of state-versus-private oil development has shaken sturdier governments in Italy than the newly formed Segni coalition. New discoveries by the state-controlled company have given foes of private development new ammunition.

Following the Petrosud discovery at Alanno, which tested about 2,000 bbl. daily of 34-gravity crude, E.N.I. made a strike less than 2 miles away. The E.N.I. location is only a stone's throw from Petrosud's concession boundary *(The Oil and Gas Journal, September 26, page 142).*

Two weeks later the Italian Government announced a second discovery 30 miles down the Adriatic Coast *(The Oil and Gas Journal, October 10, page 137).* No details have been released on either of the government wells.

B. P. to Build Hydrofiner

A 5,700-bbl. daily Hydrofining unit for desulfurizing diesel oils is being built at the 28,000-bbl. daily Hamburg refinery of BP Benzin-und Petroleum-GmbH. (British Petroleum).

The unit, which will use hydrogen from the refinery's 5,000-bbl. cat reformer, is the second scheduled by British Petroleum this year. The other is for the company's Kent refinery, Isle of Grain, England.

B.P. has a similar hydrogen-treating unit in operation at its Kwinana refinery in Australia. In addition to these units, B.P.'s own Autofining process, which provides its own hydrogen by the controlled dehydrogenation of naphthenes, is used in units at the company's refineries at Aden, Llandarcy, Wales, and Grangemouth, Scotland.

Pakistan Project Organized

Hunt International Petroleum Co. was the name chosen last week for a new company set up in Dallas to explore 20,000 sq. miles of potential oil land in West Pakistan.

Official organization of the new company is an outgrowth of agreements signed in Washington September 19 between Pakistan Ambassador Syed Amjed Ali and Nelson B. Hunt, Dallas independent, and his wife, Caroline L. Hunt.

Hunt, son of Dallas oil man H. L. Hunt, will be executive manager of the new firm. Other officers are W. H. Hunt, manager of exploration; E. D. Guinn, chief legal counsel; W. B. Beeman, personnel chief; Lamar Hunt, coordinating manager; John A. Goodson, budget and accounting director; C. M. Langton, chief geologist; C. G. Dahm, chief geophysicist; and R. A. Fox, chief stratigrapher.

Headquarters of the new company will be in Dallas, with an operating office to be set up in Karachi, Pakistan.

An estimated $42,000,000 will be spent in the Pakistan explorations.

Floods Hurt Pemex

Pipelines hardest hit by rains following hurricane

MEXICO'S storm-buffeted oil industry was back at work last week with only its drilling activity still feeling the effects of hurricanes and floods which crippled whole portions of the nation.

Major damage to industry installations was a 1,000-ft. break in five gas, crude, and butane lines which occurred when flood waters took out parts of highways and bridges between the producing fields and Mexico City. Crews of Petroleos Mexicanos repaired the breaks and had all the lines back in service within 48 hours.

Included were lines moving gas from Vera Cruz fields to Mexico City, crude lines furnishing 100,000 bbl. daily to the Mexico City refinery, an industrial gas line into Mexico City, a butane line to Mexico City, and a crude line serving the Salamanca refinery.

None of Mexico's eight refineries sustained any heavy damage, but all shut down because of flooding. All were back in operation by last week.

Major damage at Tampico was to port facilities and the loss of a tanker, Cerro Azul, which was in dry dock undergoing repairs. Winds blew the tanker into the river. The solid 6 weeks of storms reduced Mexico's exports to almost nothing during September and early October. Pemex officials said last week those export shipments will be made up just as soon as tankers are able to enter Tampico's harbor.

Drilling operations in most areas were still curtailed last week as crews waited for roads to dry out and become passable or for the flooded areas to recede enough to reach rigs.

Saudis Deny Bribe

Boundary dispute with British still unsettled

THE Saudi Arabian Government formally has denied British charges that it is trying to bribe its way into disputed territory—that may or may not contain oil lands. But their boundary disputes are still far from settled.

The British Foreign Office charged in a public statement that the Saudis have offered $8 million to relatives of the ruler of Abu Dhabi to prevent Iraq Petroleum Co., Ltd., from exploring the disputed area *(The Oil and Gas Journal, October 10, page 138)*.

The Saudi Arabs retaliated with a statement rebuking the British for the charges. They were called "hardly a constructive contribution towards a solution by peaceful and judicious methods." The Arabian statement then dismissed the charges as "untrue and unworthy of the Government of the United Kingdom."

The series of charges, countercharges, and public statements came after the British representative on an international tribunal at Geneva walked out of the conference designed to settle the disputed boundaries *(The Oil and Gas Journal, September 26, page 142)*.

Just 2 days before the Arabian statement, reports from Aden on the southern coast of the Peninsula indicated that an exploration party of Arabian American Oil Co. had been asked to leave the territory. The report from Aden said the Aramco party, escorted by Saudi Arabian troops, was encountered near Khushm al Jebel, within the boundary of the Eastern Aden Protectorate.

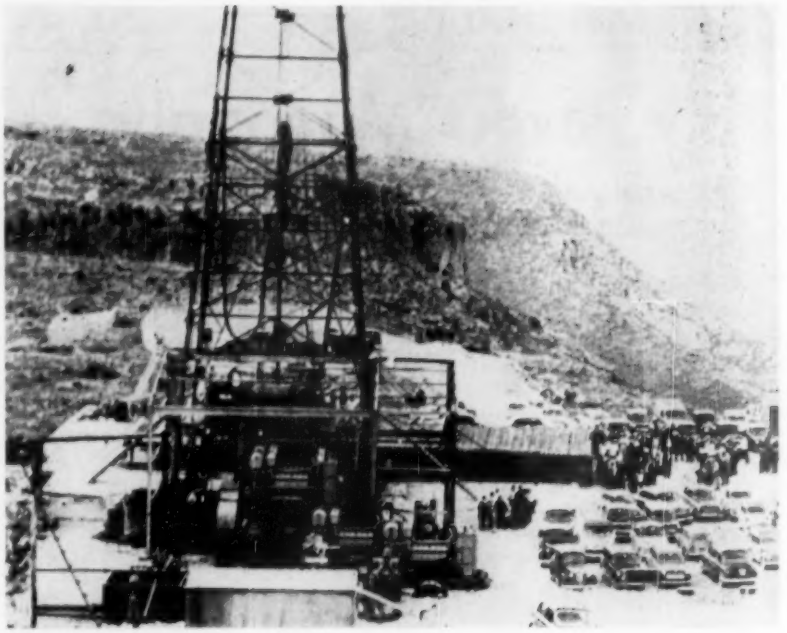
A British official stationed in the protectorate reportedly asked the Aramco party to withdraw and it complied with his request. The Briton was accompanied by native troops from the Aden Protectorate.

Failing Enters France

George E. Failing Co. of Enid, Okla., has licensed a French firm to manufacture certain Failing rigs and equipment in France.

The agreement with Societe de Fabrication de Material de Forage, Paris, will extend sales of Failing-designed rigs to France and French territories where dollars are not available.

Failing, a subsidiary of Westinghouse Air Brake Co., Pittsburgh, will provide drawings and engineering data for the French company. A Failing engineer will help launch the project in Paris next month. Sales will be handled by Failing's export sales department.



Jersey's First Test in Sicily

Melilli 1, the first wildcat Standard Oil Co. (N.J.) started in its Sicilian exploration program, is drilling below 4,848 ft. on Sicily's east coast. The well is located 7½ miles southwest of Augusta in one of three exploration blocks which Jersey Standard and Raffineria Siciliana Olii Minerali hold in partnership in Sicily. It is one of two wells being drilled by ARPE (Augusta Ricerche Petrolifere, S.p.A), the operating affiliate of the partnership. The second well is the Bronte test on the west flank of Mt. Aetna, which is drilling below 3,104 ft. The two companies have 215,000 acres under a 3-year exploration permit.

Ecuadorian Firm Gets New Bid

DIRECTORS of Anglo-Ecuadorian Oilfields, Ltd., will not recommend that stockholders accept the offer of an American company to buy 51 per cent of the stock at $7 a share. Something better has come along.

Officials of Anglo-Ecuadorian revealed that a second, and better, offer for control of the company has beeen made by Lobitos Oilfields, Ltd. The Lobitos offer amounts to the equivalent of $8.40 a share for a minimum of 51 per cent of the Anglo-Ecuadorian stock.

Frederick Bowring, Anglo-Ecuadorian chairman, revealed the American offer last month, but declined to identify the prospective purchaser *(The Oil and Gas Journal, October 3, page 98)*. Last week the American company was identified as South American Gold & Platinum Co., which now owns about 10 per cent of Anglo-Ecuadorian stock.

Lobitos and Anglo-Ecuadorian are closely allied companies and have overlapping boards of directors. Lobitos has a stock interest in the Ecuadorian company, has production in Peru, and operates a 4,200-bbl. daily refinery at Ellesmere Port on the Manchester Ship Canal in England. Anglo-Ecuadorian is the largest producer in Ecuador with a daily production of 6,800 bbl. from 320 sq. miles of concessions near Santa Elena on Ecuador's sea coast.

Reports from London last week indicated if the stock-cash offer made by Lobitos goes through, it will include application for 16-year extension of Anglo-Ecuadorian's concessions in Ecuador and the construction of a new refinery in the Latin American country. Anglo-Ecuadorian now operates a 5,000-bbl. daily refinery at La Libertad.

Italians to Explore Somalia

Ente Nazionale Idrocarburi, Italy's state-controlled oil monopoly, will send an exploration party into Somalia, formerly Italian Somaliland in East Africa. The party expects to work in the northern Migiurtina district near Bender Beila.

The Italian government company and Sinclair Somal now have exploration rights over most of Somalia. The country is now an Italian-administered United Nations trust territory. Sinclair Somal is owned half by Sinclair and the rest by Continental Oil Co., Ohio Oil Co., and Amerada Petroleum Corp.

Reds Keep Island

Japan tries to regain half of oil-producing Sakhalin

THE Japanese have gone to Russia seeking to regain the south half of Sakhalin Island, but they got nowhere with Nikita S. Krushchev, the Soviet Communist party secretary.

Historically Russian territory, the 28,000-sq. mile island off the east coast of Siberia is one of the Soviet Union's major oil-producing areas in the Far East. It was Russian territory from 1875 until the Japanese defeated Russia in the Russo-Jap war.

The Portsmouth Peace Treaty of 1905 gave Japan possession of the area south of the 50th parallel. Russia occupied the entire island with troops after Japan was defeated in World War II.

Red claims to Sakhalin and to the Kurile Islands to the east are based on the Yalta agreement between Roosevelt, Churchill, and Stalin. Sakhalin is important as a military source of oil for Russia. The estimated 19,000 bbl. daily production is along the northeast coast. It makes the Soviet far eastern military forces independent of European Russia for oil supplies.

Morito Morishima, member of a Japanese delegation visiting the Soviet Union, said Krushchev had turned thumbs down on any idea that the Japanese might regain either the Kuriles or the south half of Sakhalin. He told the delegation Russia might be willing to return Habomai and Shikotan, small islands off the northeast coast of Hokkaido.

Russia Conserves Metal

Russia's new oil-industry equipment design reflects the Soviet's intensive drive to conserve metal.

The Borets machine building in Moscow is testing an electric pump, the ENP-95, whose main parts are plastic, according to the Communist party newspaper, Pravda. The factory also is said to be producing what the Russians call a "vibrodrill." They claim it outlasts other drills "by two or three times."

Independent Enters Peru

Skiles Oil Corp., Mount Carmel, Ill., last week became the first small independent oil company ever granted an exploration concession by the Peruvian Government.

The company obtained 11 separate blocks totaling about 500,000 acres in the eastern foothills of the Andes and the upper basin of the Amazon River.

The company was founded in 1927 by Charles E. Skiles, Mount Carmel, president and the largest stockholder. The firm has producing acreage in Illinois, Indiana, Kansas, Kentucky, Oklahoma, and Texas. In addition it has undeveloped oil and gas leases in eight other states.

New Refinery in Brisbane

Bitumen & Oil Refineries, Ltd., announced plans in Brisbane last week to build a new refinery with an ultimate capacity of 10,000 bbl. daily at a cost of more than $3,350,000.

The company now operates a 6,500-bbl. daily plant at Brisbane.

The new construction will include a 10,000-bbl. atmospheric distillation unit, a 900-bbl. Platformer, and a 2,300-bbl. catalytic hydrogenation unit. The output of the refinery will serve domestic Australian markets. The new refinery is expected to go on stream by the summer of 1957.

British Hike Gasoline Price

Major gasoline marketers in Great Britain have raised prices of premium gasoline slightly more than 1 cent a gallon and credited the increase to higher distribution costs.

The increase to 4s.7d. a gallon (slightly less than 64 cents) was first made by Shell-Mex and B.P., Ltd. Other marketers, including Socony Mobil, followed. Esso had already been marketing its premium gasoline in Britain at the higher price.

The price rise prompted the London Times to question editorially whether the refining and distribution of better grades of gasoline are more important to Britain than "investment to increase supplies of fuel oil."

Saskatchewan Line Approved

OTTAWA.—Westspur Pipe Line Co. has received government permission to construct a 109-mile crude-oil pipeline to serve southeastern Saskatchewan.

The Board of Transport Commissioners approved Westspur over two other applicants, S & M Pipeline, Ltd., and Trans-Prairie Pipelines of Canada, Ltd.

Starting near Midale, Sask., the line will run to the Interprovincial Pipeline at Cromer, Man., tapping the gathering systems of the three main oil-producing areas of Saskatchewan en route. Construction on the $6,400,000 project is to start immediately.

Greece Leases Isle

St. Louis men to explore concession on Zakynthos

THE Greek Government has signed a contract with a St. Louis, Mo., group granting an exploration concession for the island of Zakynthos, southernmost of the Ionian Islands.

Martin Lerman, president of American-Greek Oil Co., heads the seven-man St. Louis group. He has signed an agreement with the government which calls for the sale of any production obtained to the government for processing in the refinery to be built near Athens. Lerman's contract calls for royalty payments to the government and four private owners.

Zakynthos, about 12 miles west of Greece's Peloponnesus Peninsula, might well be the oldest oil field in the world. The ancient Greeks caulked ship bottoms with pitch from its asphalt seeps and the use was described by Herodotus, the Greek historian, 400 years before the birth of Christ.

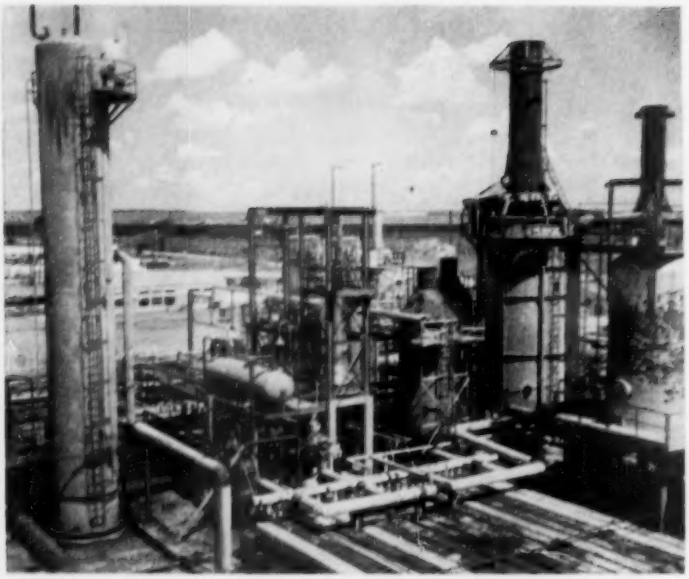
A Greek family contributed to the island's modern oil history. It drilled several shallow wells and produced about 600 bbl. daily of heavy asphaltic crude as recently as 1932. The field was shut down because there was no refining outlet.

Lerman says the Germans drilled 14 wells, all less than 1,000 ft., when they overran Greece in 1940 and were hard-pressed for oil supplies. They destroyed the wells and all production records when they withdrew 3 years later.

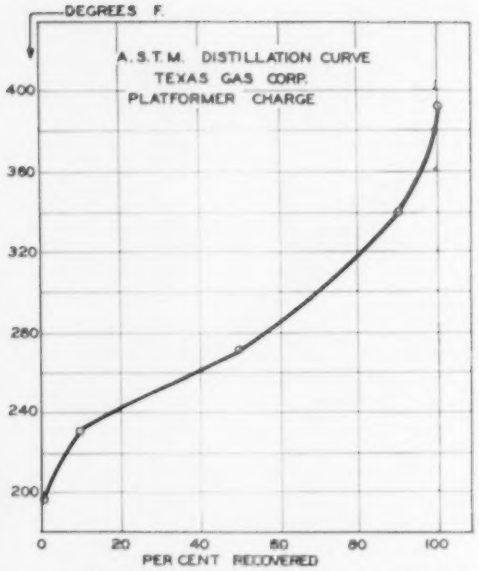
World Briefs

Royal Dutch-Shell recently announced the development of a new aviation turbine fuel which will not freeze at temperatures as low as —50° C. It was developed for use in civilian turbine-engined planes cruising long ranges and at high altitudes. The new fuel was developed from research at Thornton Research Center at Cheshire and will be used by the Bristol Britannias planes when they go into service with British Overseas Aircraft next spring.

American strides in automation have aroused envy in Russia. The official government newspaper, Izvestia, complains that the U.S.S.R. Ministry of the Oil Industry lags badly in this field. American companies are investing millions to make operations more automatic. But, the newspaper scolds, Soviet factories are not manufacturing the remote control and measuring devices required for push-button production, processing, and pipelining.



REVAMP—This photo of reformer area shows rerun column at left being taken out of service. Reactors are in center and heaters at right. At extreme right is the old reactor being removed from service.



PLATFORMER CHARGE—The new Platforming unit with capacity of 2,500 bbl. per stream day (design) was made by converting an existing Cycloversion unit. Fig. 1.

Here's how Texas Gas Corp. went about . . .

Redesigning to Boost Naphtha Octanes

by F. Lawrence Resen
District Editor

UPGRADING of straightrun naphtha to high-octane motor fuels was the goal of Texas Gas Corp. in the revamping program at its Winnie, Tex., plant installations.

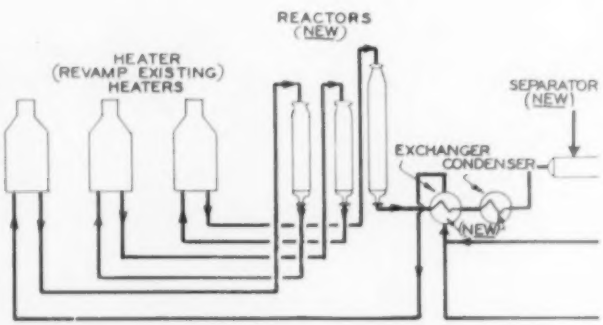
That goal was reached by converting an existing Perco Cycloversion unit into a 2,500-bbl. per day U.O.P. Platformer. Pool octane number has been upped from 86.5 to 93.5 (with 3 cc. of TEL) and unit efficiency has been increased.

The Winnie installation marks a significant addition to a developing trend which finds some operators leaning toward catalytic reforming as a means of broadening their base and competing in the marketing of premium-quality motor fuels. In so doing, conventional concepts are bypassed as in the case of Texas Gas which steps over the line into light refining operations.

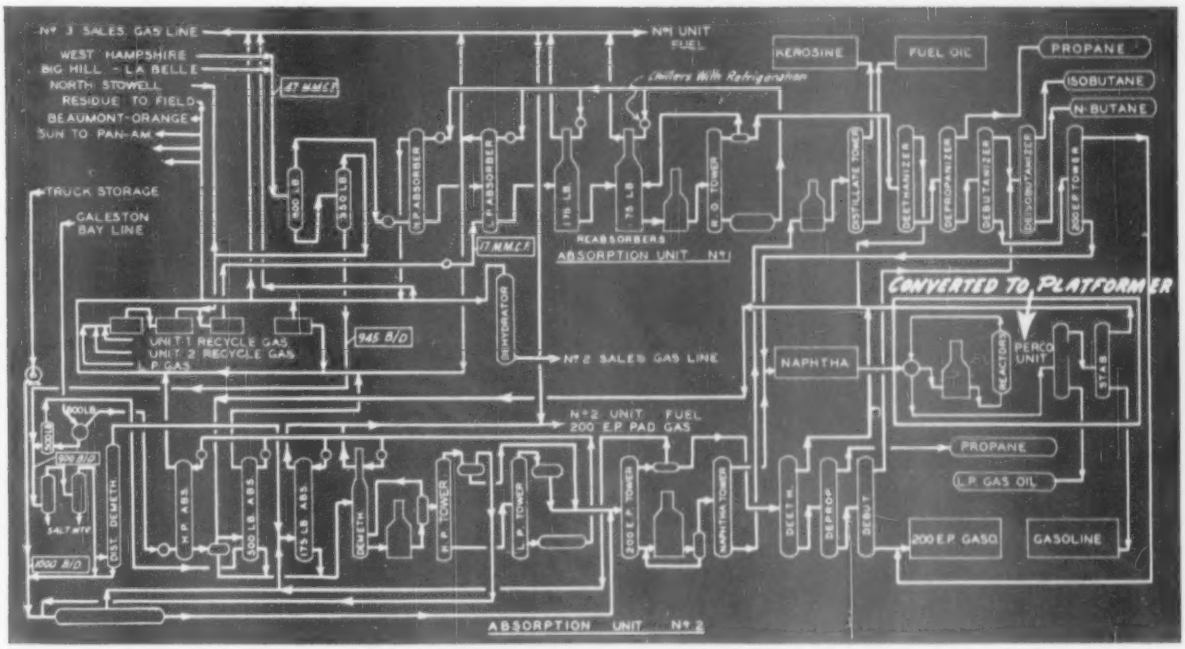
At present, the plant processes 180 M.M.c.f. of gas per day which carries into the plant about 2,500 bbl. of distillate (Table 1). An additional 2,500 bbl. of distillate is trucked and barged to the plant and the combined charge processed. About 2,110 bbl. of naphtha is available per day for Platformer charge stock, but anticipated increased throughput will add to this and it is planned to step up distillate purchases as required to provide additional Platformer feed.

Conversion . . . The new Platforming unit has a 2,500-bbl. per stream day design capacity and was made by converting the Perco unit which it has replaced in plant operations. Feed stock is a 195°-395° F. naphtha cut which is obtained from field distillate entering the plant with the gas stream plus additional distillate trucked and barged to the plant (Table 2, Fig. 1).

The new unit will produce a minimum of 95.5 research octane number with 3 cc. TEL (Table 4). This stock will be blended with 200° e.p. gasoline. The pool gasoline under these conditions will be 93.5 research octane number with 3 cc. TEL as compared to 86.5 research octane number with 3.0 cc. of lead (Table 5). Possibility exists



CHANGES MADE—Old vs. new equipment is shown here to point up changes made in process scheme. Fig. 2.



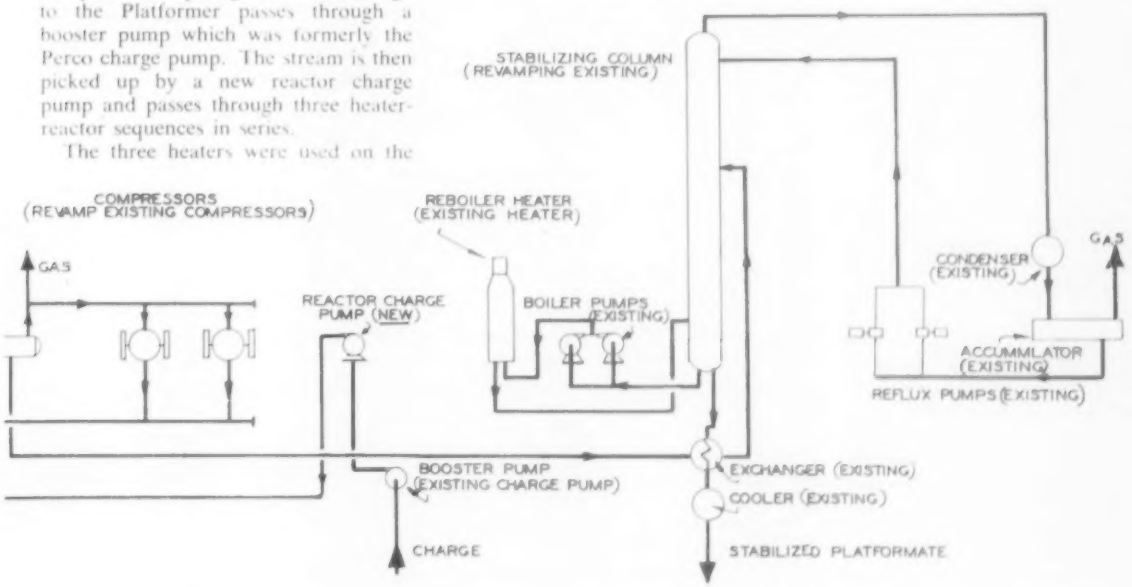
WINNIE PROCESS—How Texas Gas Corp. operates its plant at Winnie, Tex., is indicated by this flowsheet. Fig. 3.

that the Platformer may subsequently be converted to a Rexformer with the addition of a modest amount of equipment. Under such conditions, it is expected pool gasoline would jump to about 100 research octane number, leaded, placing the plant in a more than competitive position.

Conversion . . . Revamping of the Perco unit resulted in considerable savings since most of the existing equipment auxiliaries were adaptable for Platformer service. A rundown of the process scheme and the old vs. new equipment will point this up (Fig. 2). Initial charge to the Platformer passes through a booster pump which was formerly the Perco charge pump. The stream is then picked up by a new reactor charge pump and passes through three heater-reactor sequences in series.

The three heaters were used on the previous unit and only required retubing for the new service. The three reactors were naturally new, as was the special alloy piping in the reactor section which had to be installed. The charge from the third reactor in series passes through an exchanger (new) and condenser (new) before entering a new separator. Overhead gas from the separator passes through existing compressors and is recycled into the charge stream. These were revamped by installing new cylinders suitable for the new process. A considerable amount of additional compressor capacity is available if the unit is later expanded. The unit design calls for 225-hp. compressor capacity with two 400-hp. compressors being installed. Additional heating capacity is also available.

Liquid from the separator is charged to the same stabilizer column used in the previous setup. This is a 3-ft. by 35-tray tower with 2-ft. spacing. A new set of bubble-cap trays were installed in this tower. The remaining equipment in the process flow was previously available: A bottom stream is pulled off and circulated through an existing reboiler heater; tower plat-



formate bottoms pass through existing exchanger and cooler; and tower overhead passes through an existing condenser and accumulator with existing reflux pumps picking up accumulated liquid and injecting them in the top of the tower. Unused equipment mainly included two reactors and rerun column.

The instruments in the unit were all available either from the Perco unit or a now nonexistent chemical plant which used to be adjacent to the plant. The control room is being modified to the extent that the instruments are being restacked in the control panel to improve operator's conditions.

Over-all plant . . . To best understand the operations at Texas Gas Corp.'s plant, the current plant system will be described and its application under the previous setup will be reviewed.

The Winnie installations contain essentially two absorption-type units (Fig. 3). With the exception of a single butane splitter and the topping of the light crude stream in a common unit, both units are essentially independent operations. Consideration has been given to modifying the naphtha still and adding a second deisobutanizer so that each unit can handle processing and topping completely apart from the other.

Plant No. 1 receives both a high and lower-pressure gas stream. About 57 million cubic feet of high-pressure gas at 800 psi. is received primarily from three fields: West Hamshire, LaBelle, and Big Hill. The full stream delivered passes through two-stage separation, at 800 and 350 psi., to knock out condensate. This liquid, about 1,000 bbl. per day, is pressured to the 180-psi. surge drum in plant No. 2 for charge to the topping unit. Yields are in Table 3.

High-pressure gas from the separator is cooled to 65° F. and then charged to the 800-psi. absorber and contacted with 65° F. lean oil. Residue gas is scrubbed and enters the suction of booster compressors. These deliver the gas to dehydrators and final delivery to sales lines.

The low-pressure absorber receives two streams. One is the rich oil from the 800-psi. absorber which is flashed on the eleventh tray of the 475-psi. absorber. The second stream is 16 million cubic feet of 475-psi. gas charged to the base of the absorber. About 13 million cubic feet of this low-pressure charge gas is picked up from oil wells and delivered to the plant through a 30-in. line operating at 4-in. Hg vacuum. This gas is compressed by nine 800-hp. compressors in three stages. The gas charge is cooled to 60° F. and then enters the absorber.

The remaining low-pressure gas charge is delivered from North Stowell field and injected at the discharge of the second stage of compression. This is commingled with the wellhead gas being compressed and is charged as a common stream to the absorber at 475 psi. The gas charge, after being cooled, is contacted with 65° F. lean oil in the absorber, is scrubbed, and the residue delivered to Neches Butane Products Co. (now Texas-U. S. Chemicals Co., Port Neches) totaling 19 M.M.c.f.

Rich oil from the 475-psi. absorber bottom is flashed to 175 psi. in a nonheated reabsorber and is flashed again to 75 psi. in the same manner. Cold lean oil is contacted with flash gases from the 175-psi. flash and both residue-gas streams enter the fuel system.

Rich oil is next preheated by exchange with still bottoms; additional heat to 500° F. is furnished by a direct-fired furnace. The still operates at 160 psi. and is steam stripped. Absorbed products are separated from lean oil in the still and charged to the deethanizer. Deethanizer bottoms pass through a depropanizer for overhead propane product recovery and its bottoms are charged to the debutanizer. From here iso and normal overhead make is charged to a splitter for iso and normal products.

The debutanizer bottom product is stabilized to 10 lb. R.v.p. and charged to another tower to make a 10-lb. R.v.p. 200° F. e.p. cut. The 200° F. e.p. cut goes to a 2-psi. gas pad storage and is blended with the reformed gasoline from Perco operations for final blending of gasoline. Bottoms from the 200° F. e.p. tower pass to naphtha storage for subsequent charging to the Perco unit.

No. 2 plant . . . The gas charge for the second absorption unit comes primarily from three fields: Jackson Pasture, Willow Slough, and Seabreeze. A total of 102 million cubic feet is delivered to the plant at a pressure of 800 psi. The condensate is removed in two-stage separation at 800 and 500 psi.

This condensate is then commingled

TABLE 1—PLANT CHARGE

No. 1 Unit	
Low-pressure gas (475 psi.), M.M.c.f.	16
High-pressure gas (800 psi.), M.M.c.f.	57
Field distillate (with gas), bbl.	1,250
No. 2 Unit	
High-pressure gas (800 psi.), M.M.c.f.	102
Field distillate (with gas), bbl.	1,250
Field distillate (trucks and barge), bbl.	2,500

TABLE 2—NAPHTHA CHARGE FOR REFORMING UNIT

I.b.p., °F.	194
10 per cent, °F.	230
50 per cent, °F.	270
90 per cent, °F.	338
E.p., °F.	392
Gravity, °A.P.I.	55.7
Research octane number:	
Clear	45.7
+3 cc. TEL	71.1
Paraffins, per cent liquid volume	54
Naphthenes, per cent liquid volume	36
Aromatics, per cent liquid volume	10

TABLE 3—AVERAGE PLANT YIELD

	No. 1	No. 2	Dist.-topping	Perco	Platformer (design)
Propane, bbl. per day	350	524	84	30	74
Isobutane, bbl. per day	180	293	63	10	41
n-Butane, bbl. per day	175	275	75	5	
200° e.p. gasoline, bbl. per day	277	375	1,160		
Naphtha, bbl. per day	65	95	1,950		
Kerosine, bbl. per day			1,150		
Gas-oil, bbl. per day			230		
Reformed gasoline, bbl. per day				1,880	*2,473
Gas, M.c.f. per day				715	1,656

*Includes 8.3 liquid volume per cent makeup n-butane for 10 lb. R.v.p.

TABLE 4—PROPERTIES OF PLATFORMATES
(Design basis at 2,500 bbl. per day charge)

	Hexanes	Pentanes plus	Butanes plus	10-lb. gasoline†
Yield, liquid volume per cent of reactor charge	82.0	86.7	*90.6	98.9
Degrees A.P.I.	47.5	49.5	51.5	
R.v.p.	1.1	2.2	5.2	10.0
Mol. wt.	106	104	101.5	
F-1 clear octane number		83	83.5	84.5
F-1 + 3 cc. TEL		94.7	95	95.5

*Over-all C_5 10ss 1.0 liquid volume per cent. †Add 8.3 liquid volume per cent (based on charged) n-butane for 10 lb. R.v.p.

TABLE 5—POOL GASOLINE CHARACTERISTICS AFTER PLATFORMER INSTALLED (Design Basis)*

	Bbl. per day	Per cent	3 cc. R.O.N.	Per cent R.O.N.	R.v.p.	Per cent R.v.p.
Reformate	2,082	53.4	95.5	50.9	10.0	5.3
200° e.p.	1,812	46.6	91.4	42.6	10.5	4.7
Total	3,894	100.0		93.5		10.0

*On basis of 1,452 bbl. naphtha charge currently available.

with the distillate from No. 1 plant and pressured through vessels into the distillate surge drum for charge to the topping unit. A two-stage pass through treaters is the first step for the commingled distillate streams. This is done to knock out the salt water, after which the stream enters a demethanizer tower, with the bottom stream entering the surge drum.

The gas stream meanwhile passes through a similar sequence to that followed in the No. 1 plant. The 800-psi. gas is cooled to 65° F. and charged to the absorber and contacted with 65° F. lean oil. About 72 M.M.c.f. of residue gas is delivered to Pan American Gas Co. and the remaining volume is used to complete sales delivery at No. 1 plant (total 65 M.M.c.f.) and for gas-lift purposes.

Rich oil is flashed in a drum at 500 psi., with flash gases entering the bottom of the 500-psi. absorber with flash gases from the 500-psi. distillate separator. Lean oil at 65° F. contacts the flash gases with residue gas going to boiler fuel. A 175-psi. reabsorber in the plant receives a gas charge from vent lines running to the distillate surge drum and 200° F. e.p. tower accumulator. This gas is contacted with 65° F. lean oil and residual gas is used for fuel.

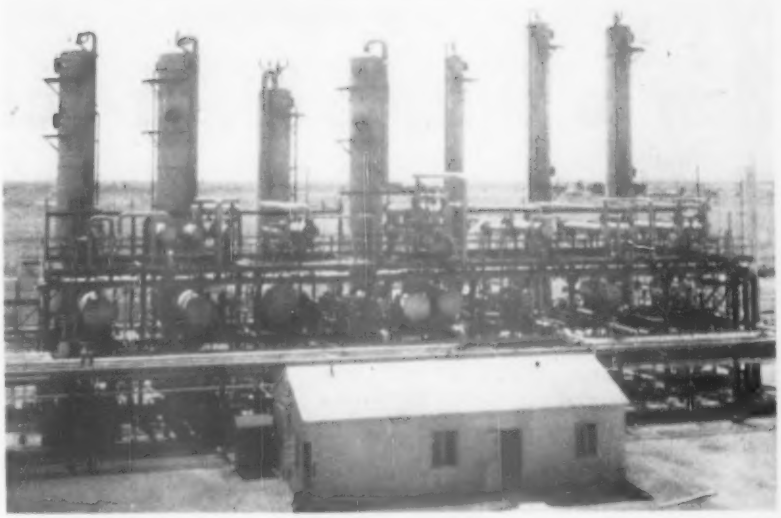
The combined rich-oil stream is preheated and charged to a demethanizing reabsorber. Demethanizer bottoms are controlled at 290° F. by hot flash vapors from stripper charge. The absorbing section is contacted with cold lean oil and rich oil from the demethanizer is further preheated by heat exchange with hot stripped lean oil. Hot rich oil is then heated to 500° F. in a direct-fired furnace and charged to a 190-psi. stripper for light stripping.

The 190-psi. stripper bottoms are charged to a 60-psi. stripper for final stripping of the lean oil. The overhead make from both stills is charged to the 200° F. e.p. still in a commingled stream with distillate from the 180-psi. surge tank. A 200° F. e.p. cut is made overhead and charged to the deethanizer. The sequence following is identical with plant No. 1 with deethanizer bottoms passing into the depropanizer and debutanizer steps. As previously noted, no butane splitter is available in Plant 2, and the debutanizer overhead is commingled with the charge to the splitter in Plant 1.

The 200° F. e.p. still bottom product is charged to a naphtha tower to make a 200°-400° F. naphtha cut. This cut is transferred to storage to be used as charge stock for the Platforming unit. Bottoms from the naphtha tower are charged to the distillate tower in No. 1 plant to produce 575° F. kerosine and gas-oil products.

TABLE 6—POOL GASOLINE CHARACTERISTICS PRIOR PLATFORMER OPERATIONS

I.b.p., °F.	99
5 per cent, °F.	129
10 per cent, °F.	137
20 per cent, °F.	150
30 per cent, °F.	164
40 per cent, °F.	182
50 per cent, °F.	203
60 per cent, °F.	224
70 per cent, °F.	247
80 per cent, °F.	275
90 per cent, °F.	315
95 per cent, °F.	346
E.p., °F.	376
Per cent recovery	98.0
Per cent residue	1.0
Gravity, A.P.I.	65.1
R.v.p., psi.	9.5
Research octane number:	
Clear	67.4
+3 cc. TEL	86.5



ABSORPTION UNIT—This is over-all view of absorption unit No. 2, with part of absorption section at extreme right.

Refrigeration . . . An interesting aspect of the absorption units is the refrigeration system, which uses isobutane as the refrigerant. A combination of conditions warranted the use of this material which normally is not as economical to use as propane. If idle plant equipment had not been used, payout for new equipment would have been 20 years. The necessary horsepower for the system was already available in existing compressors as were heat exchangers. However, both the compressor cylinders and the exchangers had pressure ratings not suitable for the propane use (isobutane is expanded only from 75 to 5 psi.). Meanwhile, the incoming gas is not dehydrated, thus it is necessary to remain above the hydrate point, and streams are cooled only to approach hydrate conditions. This requirement meant the isobutane could serve satisfactorily.

Therefore on the basis of availability of the refrigerant and equipment (only new purchase was for lube-oil butane heaters) the economics dictated the isobutane system. It might be noted that were the system completely new, propane would probably be selected due to its lower material cost, and lower horsepower requirements plus its better refrigeration action.

Perco unit . . . Under previous operating conditions, the 200°-400° F. cut was charged to the Perco unit to produce a reformed gasoline which was blended with 200° F. e.p. product, leaded and dyed for a finished motor fuel.

The naphtha was preheated in four banks of fin-tube exchangers with final heat being added in direct-fired heaters to bring the temperature up to 1,070° F. The hot vapor was passed through a bauxite catalyst bed and then used to preheat the naphtha in the fin-tube exchangers. Charge then passed to a rerun tower to adjust end point of the gasoline and remove heavy ends. Rerun overhead was charged to a stabilizer to produce a 10-lb. R.v.p. reformed gasoline. Gas from stabilizer overhead was compressed and charged to the 500-psi. absorber in plant No. 2. Pool gasoline characteristics under these conditions are listed in Table 4.

Acknowledgments

The cooperation of Texas Gas Corp. management in the release of this information is gratefully acknowledged along with the cooperation and assistance rendered by Mixson Kincannon, manager of the manufacturing department, and R. L. Huff, chief plant engineer.

A veteran water-flood engineer tells you

How to Increase Water-Flood Profits

Modern water-flood treatment should include . . .

Control of . . .	. . . in order to control . . .
1. Suspended matter	1. Cost of injection
2. Chemical precipitation	2. Cost of production
3. Algae and bacteria	3. Total oil produced
4. Corrosion	4. Profits
5. Clay swelling	
6. Surface forces	

by Robert R. Hawkins
Consulting Engineer

WATER injection has become big business. Oil production by water flooding alone is now close to 300,000 bbl. per day. And this does not include the oil produced by pressure maintenance which would add many thousands of barrels per day more. Over 1,800 projects are in operation. Some 3,500,000,000 bbl. of oil will be recovered by future flooding of present marginal leases, according to estimates of the National Stripper Well Association.

The water needed to produce this oil will reach into the hundreds of billions of barrels. When added to the ever-increasing volumes of salt water for disposal, the figures become hard to grasp.

All of this water will require treatment. Conditioning in varying degrees will be needed for every barrel injected. Profitable financial returns in the form of greater recoveries of lower-cost oil, together with trouble-free injection operations will depend on the **controls** exercised over this treatment.

These factors should be controlled:

1. Suspended matter
2. Chemical precipitation
3. Algae and bacteria
4. Corrosion
5. Clay swelling
6. Surface forces

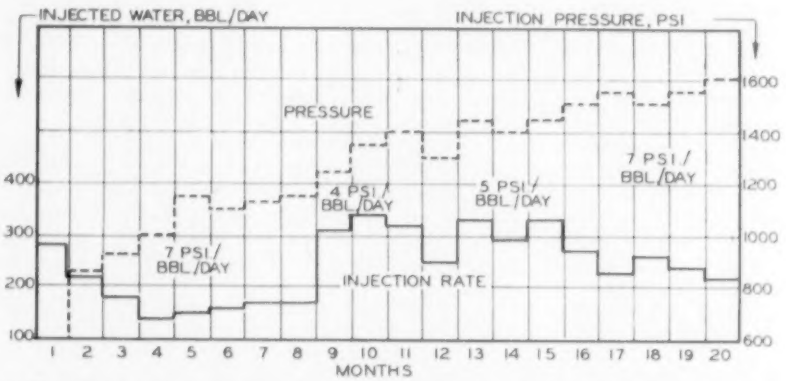
In the early days of water flooding (there was no pressure maintenance or salt-water disposal) **none** of these controls were exercised. As the method became more widespread, their importance was slowly recognized and, almost one by one, they were adopted. It is only within the last 5 or 6 years that the list has become complete. In fact, control of surface forces is still subject to considerable controversy.

Control 1—Suspended Matter

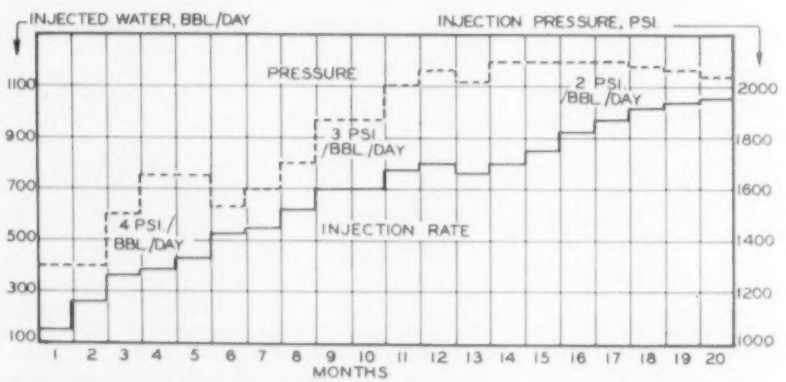
In the earliest water floods, 35 years ago, water pumped directly from an aquifer was used. This water was clean and clear. Nevertheless, the oil sand in every well became plugged to some degree. Then sand filters were installed and the amount of plugging was reduced. Incomplete filtration is now known to be at least partially responsible for the continued (and unnecessary) decline in the injection rate after the complete pressure distribution pattern has been extended to the surrounding producing wells. A characteristic decline curve, with concurrent pressure increases, is shown in Fig. 1. Plugging of the sand in this well is quite evident.

Best type of filters . . . After the fill-up and relief pattern has been completely established, the injection rate should **increase** as more oil is produced if no plugging occurs. It is now generally recognized that maximum injection rates are attained and **maintained** only with asbestos-precoat diatomite filters. As an example, these filters make available an iron-free water not possible with sand or anthrafilt beds. Fig. 2 shows a characteristic injection curve—with concurrent pressure increases needed only during the first two-thirds of the period. Proper filtration together with adequate chemical treatment results in the complete absence of plugging.

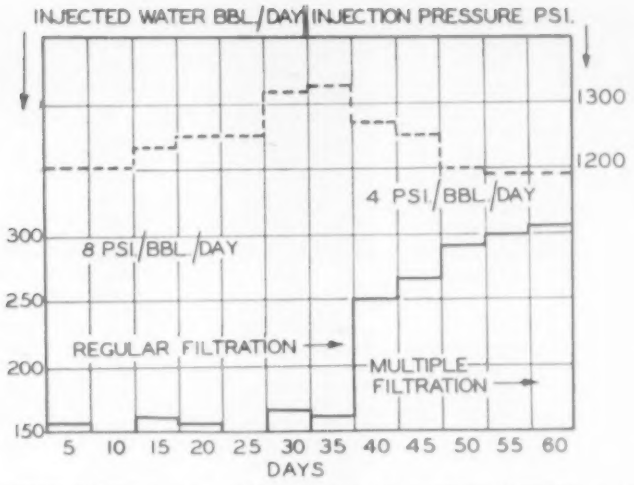
For tight sands, multiple filtration may be necessary. Its effect on the injection rate is shown in Fig. 3. Here



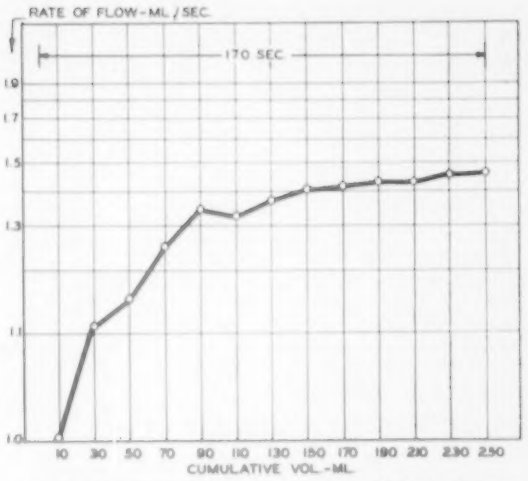
PLUGGING is evident from declining injection rate with concurrent pressure increases. Fig. 1.



PROPER FILTRATION decreases pressure required to obtain increased injection rate. Fig. 2.



TIGHT SANDS require multiple filtration for maximum injectivity to be obtained. Fig. 3.



CONTROLLED WATER, treated with surfactants, increases in rate of flow in plugging test of sintered glass disk. Fig. 5.

the energy expenditure dropped from 8 lb. psi. per barrel per day to 4 lb. psi. per barrel per day without change in chemical treatment but entirely as a result of multiple filtration.

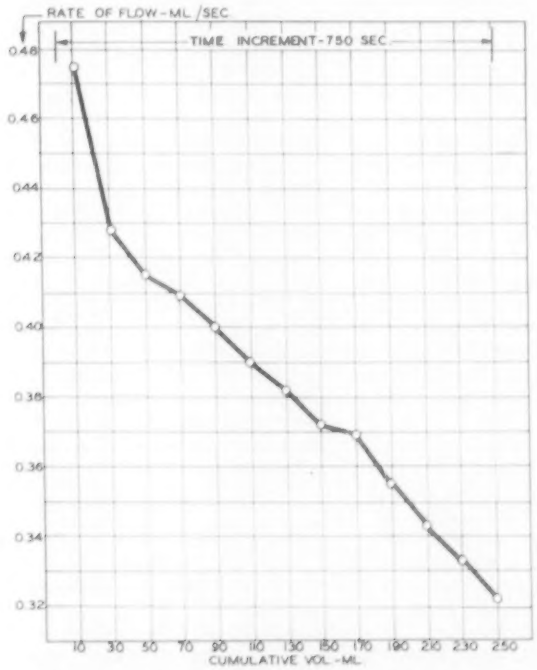
Proper filtration control contributes to an increased rate of production thus shortening the life of the flood with a consequent reduction in operating costs.

Control 2—Chemical Precipitation

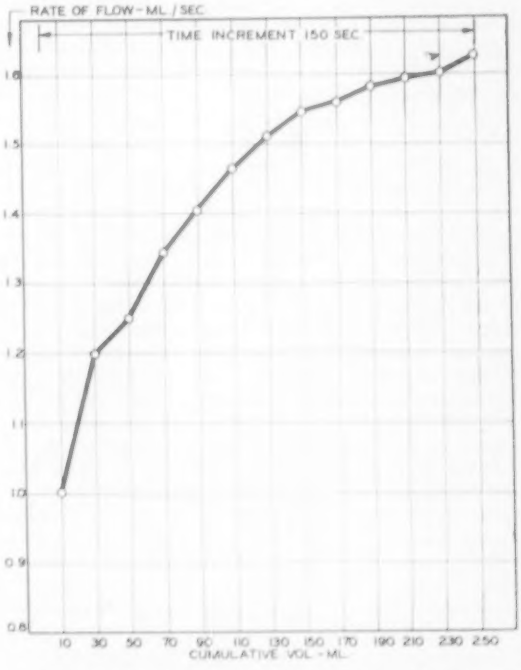
Control of chemical precipitation was initiated about 20 years ago because scale, forming on the sand face, caused a very rapid decline in the injection rate. Acid and reshooting restored the rate but, since these methods were expensive, some operators began treating their water with chemicals. Frequently the treatment resulted in worse conditions, since these chemicals were themselves excellent plugging materials when incorrectly used.

The theory involved called for complete stabilization of certain of the scale-forming mineral compounds as was successfully practiced in fresh-water treating plants. And fair results were obtained as long as the operation was confined to fresh-water injection. But oil-field brines too often contain high salt concentrations that act as buffers and slow the desired chemical reactions, thus preventing stabilization within the required time limits. This factor often makes the use of dolomite or marble beds impracticable. So the method of stabilization when applied to oil-field brines has not been entirely satisfactory.

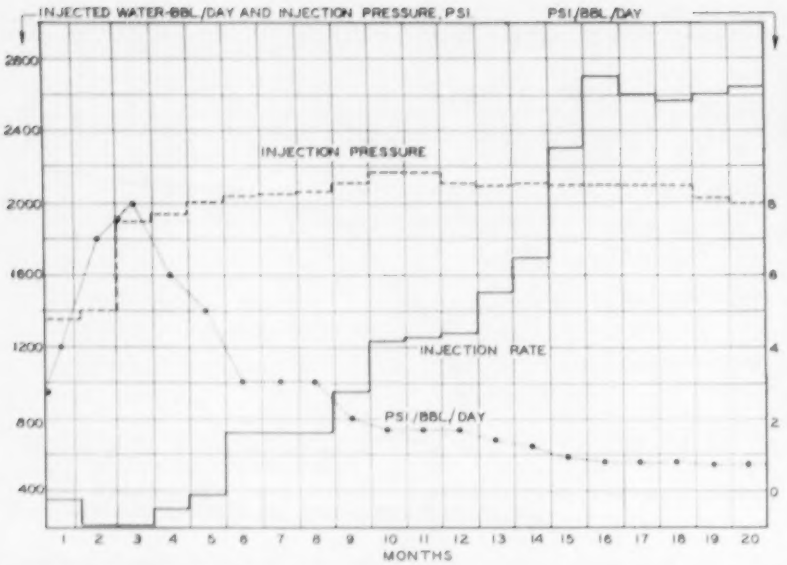
New concept . . . Within the last 5 or 6 years, a completely different concept of the control of precipitation has entered the practice of water conditioning. With this method such stabilization as does occur is incidental to the main purpose. For instance, when brine is aerated or when two or more



NORMALLY TREATED water flows through sintered glass disk with decreasing rate in plugging test. Fig. 4.



FASTEST FLOW is obtained in plugging test with controlled water in which calcium ion predominates. Fig. 6.



INCREASED INJECTIVITY resulted when surfactants were used in flood water where all water controls were used. Fig. 7.

disparate waters are commingled prior to treatment, precipitation may result. This can be beneficial but the precipitate must be removed by sedimentation and filtration.

Precipitation most commonly results from chemical reactions involving calcium and magnesium and to a lesser extent iron or barium. Complex alkali phosphates and certain organic compounds are able to look up these ions and to hold them in such tight combinations that they are unable to react and form precipitates. These agents may be said to "swallow up" the trouble-making ions. This is called sequestration.

Sequestering agents . . . One such sequestering agent, a mixture of the soluble salts of amino carboxylic acids, is very useful in the sequestration of iron even in the presence of calcium and magnesium. An advantage of this organic type is its resistance to decomposition. The polyphosphates might, under certain conditions, revert to the insoluble orthophosphate, thus not only losing their sequestering effectiveness, but also becoming themselves plugging agents. Surface active materials are able to sequester in at least two ways. One is by hindrance of crystal growth. Another, by soluble complex formation which is effective both in scale and corrosion prevention.

Increased knowledge of the use of sequestering agents and of certain cationic surfactants has led to methods of treatment that are more efficient and less expensive than those using stabilization; much less expensive when the cost of repairing plugged wells is considered. The use of closed systems with the newer methods is advantageous unless precluded by the presence of large quantities of hydrogen sulfide. Or it might be desirable, under certain conditions, to speed up the release of carbon dioxide from solution, thus precipitating the scale-forming carbonates and sulfates which are later filtered out.

But these are special circumstances. The usual applications of the newer treating methods call for rigid control of **all** chemical precipitation.

Control 3—Algae and Bacteria

Control of algae and bacteria was not so vital as long as water flooding was confined to the Pennsylvania-New York area. Since the water used for injection came from aquifers with temperatures around 60° F. growth of bacteria and algae was retarded. When flooding moved into Oklahoma and Kansas where higher average temperatures prevailed and more surface water was used for injection, the need for control became urgently evident.

Since the greeen slime denoting algae growths was readily visible, control of this plugging agent was first attempted. Copper sulfate, and later chlorine, were used with fair success but certain strains could become immune to either treatment.

This was true to an even greater extent when, later, attempts were made to control bacteria by the use of chlorine. Here again, certain types, especially the anaerobic sulfate-reducing bacteria, cannot be completely controlled. Sodium tetrachlorophenate in batch treatments is effective where conditions permit its use. How these bacteria are able to resist the toxicity of chlorine is not entirely understood. Rapid multiplication in favorable environments could be a partial explanation.

Cationic surfactants good . . . A method of control of algae and bacteria that does not rely on toxicity has been in use for the last 5 or 6 years. The ability of certain surfactants to plate out and thus to coat microorganisms is utilized. These are the quaternary ammonium salts, among the first surfactants to be developed. Although they were first manufactured in the early twenties, it was not until 1935 that, Domagk, discoverer of the sulfa drugs, reported the extreme effectiveness of the quaternaries in killing bacteria. Since then hundreds of new ones have been synthesized and many have been marketed as highly efficient germicides. Their effectiveness can be further increased by adding a sequestering agent.

For injection purposes, where completely sterile water is, of course, unnecessary, only 5 to 10 p.p.m. of the surfactant is used under normal conditions for complete control of both algae and bacteria. Thus, complete freedom from these trouble makers may cost less than 2 mills a barrel. In other words, one cleanout or reperforating job costing under $2,000 would pay for the chemical needed to treat more than 1,000,000 bbl. of water.

Control 4—Corrosion

Control of corrosion has passed through several stages since it was first noticed that some waters caused more line leaks than others. For a while it was closely linked with the attempted control of precipitation. Many operators, following the common practice of municipal water plants in line protect-

THE AUTHOR

R. R. Hawkins, Los Angeles consulting engineer, is highly qualified to discuss methods of treating water to be injected into underground formations for water flooding or waste disposal. It has been practically his sole job for the past 20 years. After attending University of Missouri and Missouri School of Mines and Metallurgy in 1918, he joined Gulf Oil Co. at Glenpool, Okla. After switching to The Texas Co. he became division engineer in 1926 and division superintendent in 1934. During 1936 and 1937, after spending a year in Pennsylvania fields studying secondary recovery methods, he worked on several gas repressuring and water-flood projects in the Mid-Continent.

During the next several years he directed floods in Kansas, Oklahoma, Illinois, and Kentucky for several independents. Since 1947 he has been associated with California floods, first with Signal Oil & Gas Co. and then as manager of water flooding for Fullerton Oil Co. From 1953 to last April, when he resigned to enter the consulting field, Hawkins was manager of Waterflood Oil Co., operator of a small flood near Fillmore.

tion, allowed a coating of scale to build up in their injection lines. This required a very delicate adjustment of precipitation to avoid plugging the sand with the scale-forming material. This method was especially difficult to handle where brines were being recycled.

Cement-lined pipe and corrosion-resisting materials were next utilized and, aside from the extra cost, they were generally satisfactory. But except under very unusual conditions, they have been proven superfluous by the adoption of cationic surfactants for the control of microorganisms.

Surfactants effective . . . The ability of the quaternaries to plate out is here used to form a molecular film on metal surfaces. This protection is practically complete (except for electrolysis) even under extreme conditions such as those caused by hydrogen sulfide or oxygen. Protection has been afforded plain steel filters and unlined steel pipelines, where the pH of the injection water was reduced to 2-3 by the addition of acid. A useful attribute of these surfactants is their compatibility with other chemicals (except anionics). They assist the phosphates and they make practicable the use of sodium sulfite for oxygen removal to control certain reactions or to prevent oxidation of oil within the sand.

Red water plugging and costly line leaks can be entirely eliminated by the use of corrosion controlling water.

Control 5—Clay Swelling

The control of clay swelling was not recognized as having much importance during the early days of water flooding. Perhaps it was not even necessary in the fields then under flood, since the sands were reasonably free of clay material. But when fresh-water flooding was attempted in the so-called "dirty" sands in the Mid-Continent, the results were disastrous. One pilot flood lasted less than a month.

Fewer and fewer clean sand fields remain wherein injection for increased recovery or for disposal has not been applied. Actually, some entire regions —notably California—have almost no oil-producing formations that are completely free of clay. Thus the importance of the control of clay swelling has become more generally recognized and, with the rapid increase in the number of disposal, maintenance, and flooding projects in these areas, it will become absolutely necessary. Many laboratory tests on water-sensitive cores have shown that complete plugging can result from the introduction of untreated water.

The theory of base exchange reactions as applied to the swelling of clays has been understood for many years by agricultural investigators. It was known that clays of the montmorillonite group hydrate most rapidly and, in so doing, increase the size of the individual particles as much as 14 times.

The application of this reaction to the clay minerals in oil reservoirs has become generally understood only within the last 10 or 15 years. But only since 1950 have actual field control methods been developed. In very few plants has the positive control of clay swelling been in operation for as long as 3 or 4 years.

It was first realized that brine causes less swelling than fresh water when it was used for washing rotary-drilled wells. The results with formation water were far more satisfactory than with fresh water. When brine was not available, common salt was added to fresh water, or sea water was used, without determining whether the sand contained sodium or calcium montmorillonite. Obviously, the predominant sodium ion in either water would disintegrate the calcium clay in a continental deposit, such as the Sespe, a Tertiary fresh-water deposit.

Salts decrease swelling . . . In addition to control with brine, experiments in both laboratory and field showed that swelling could be prevented by adding acid to fresh water. At first, in a few plants, hydrochloric acid was fed continuously into the injection water. It was known that the quarternary surfactants (added to control corrosion and microorganisms) were able to control swelling when used in conjunction with or after acid injection. It was later learned that they could do this without the use of acid. Their ammonium chloride ions neutralize—as do those of the metal salts—the electrical charge surrounding the clay particles and thus prevent normal water adsorption.

Field usage and laboratory tests have both definitely proved that after the application of a quaternary to a water sensitive sand, fresh water can then be injected without serious clay swelling. Frequently, the injectivity index will closely approximate that of the formation brine. Treatment of injection water with the correct surfactant results in a cheap and satisfactory control of clay swelling.

Control 6—Surface Forces

Attempts to control by chemical means the surface forces involved in oil production are as old as water flooding itself. Many chemicals were tested in the laboratory and a few were given field trials. They ranged from the simple inorganics, such as soda ash and caustic soda, to more complex compounds. But field tests always resulted negatively even though laboratory work showed that surface active agents could reduce oil saturations considerably below those obtained with plain water. The main cause of failure under reservoir conditions was adsorption of the agent on the sand grains.

Only recently have a large number of surfactants been developed commercially that are capable of interfacial tension reduction with only slight adsorption. These are the nonionics. They belong to a group of surface-active agents—composed of a complex structure of molecules—that have the ability to collect at the interface, replacing the normal surface molecules, and thus radically changing the physical relationships involved. In the nonionics, the entire molecule is water soluble. In the ionics, one end is oil soluble while the other is water soluble. They are anionic or cationic according to the charge on the oil-soluble ion.

Oil-field use has been confined to the cationics—for control of microorganisms and corrosion, and to nonionics—for control of surface forces. Of course, the cationics themselves have decided effects on tensions and when used with the nonionics in water treatment, the results far exceed those of an equal amount of either chemical when used alone.

Combination best . . . The beneficial effect of this synergistic action makes the use of a combination of surfactants quite important. It is common practice to add "builders" to them for commercial usage. Sodium carbonate and sodium bicarbonate, sodium silicates, and trisodium phosphates are the chief additives used. Even common salt increases the rate of reaction of the ionic surfactants. Although the problem is constantly being studied, it will probably be a long time before complete understanding is attained of how these builders and surfactants work together to do such an effective job.

Thus the benefits obtained by the use of a combination of nonionic and cationic surfactants may be enhanced when the oil and the natural brines contain materials which add a triggering effect to the reaction. The assistance given by these naturally occurring polar compounds in the displacement of oil by water has been frequently demonstrated in the laboratory. Also, when they are removed from certain crudes, the interfacial tension with distilled water may increase as much as 25 per cent.

Certain alkali solutions against these crudes may give interfacial tensions of almost zero. When surfactant-treated-water has passed through an oil sand where some of these compounds are present, interfacial tensions between the produced oil and water may be lower

than 5 dynes per centimeter. The legitimacy of applying laboratory flooding results, obtained with surfactants and artificial brines, to possible recovery in oil fields where some of the above materials are present, may be questionable. Furthermore, in the secondary phase the influence of these factors on attrition may be economically significant.

Agreement in the controversy as to whether surfactants can increase recovery seems to require that the sand be oil wet if beneficial results are to be obtained. While it is true that most sands are water wet when measured under static conditions, many of them may, in effect, become dynamically oil wet when invaded by water moving within a certain velocity range. Theoretically, an oil wet sand will show increased recoveries with increased pressure gradients and by the use of surfactants. If the sand is dynamically water wet, neither may be beneficial. Because of the effect of velocity on wettability, tests with a Bartell cell may not be conclusive.

Controlled water penetrates . . . Of two possible reasons for using surfactants in the control of surface forces, (1) increase in oil recovery, and (2) increase in injection rates, the latter can be proved with fewer complications. Many field tests and actual operations obtain increased rates at lower pressure. Basically, surfactants permit the penetration of smaller capillaries. That there may be another factor involved, whereby the "controlled" water is assisted through the pore openings of tight sands, seems to be indicated. Figs. 4 and 5 represent, in modified form, the Cerini plugging test when applied to water treated by the usual methods (Fig. 4), and to completely controlled water (Fig. 5). In the former, 250 ml. of water passed through the sintered glass disk in 750 seconds, while in the latter, the same amount passed through in 150 seconds or in one-fifth the time. Here, the rate of flow was **increasing** with time. Fig. 6 also shows the results with controlled water in which the calcium ion predominates. The samples were all taken from operating injecting plants. It is interesting to note that, usually, these results can **not** be duplicated with laboratory treated water using the same chemicals and methods.

Surfactant front? . . . It is believed that reasonable control of surface forces was exercises in the well whose early history is depicted in Fig. 7. Both cationic and nonionic surfactants were used in the water injected into this well. The other five controls were also in effect. The pressure per barrel of injected water increased during the fill-up period and then decreased in steps as the various strata were flushed out. Adsorption of the cationic with the passage of many pore volumes of water through the sand in the immediate area of the well bore is a possibility. If this actually occurs under field conditions, the benefit to be derived from the cationic may be considerably greater than if no moving surfactant front exists. The effect on oil recovery might be appreciable.

In the control of surface forces through the use of surfactants, just how important a factor possible increased recoveries may be has not yet been fully evaluated. But where maximum economic injection rates are required, their use is amply justified.

It was said as early as 1935 that, "The flow which gives the greatest loss of pressure per barrel of fluid input in parts of the sand where most oil is, is the best flow." Since this is still true, pressure expended throughout the oil sand rather than wasted by plugging effects at or near the sand face, should lead to the highest possible injection rates and oil recoveries.

MASS SPECTROMETER used for testing gas extracted from drilling mud.

MOBILE LABORATORY which carries mass spectrometer to drilling site for mud sampling.

Hycalog Introduces Mud-Logging Method

A NEW method of mud logging is being used by Hycalog, Inc. of Shreveport, La. This method uses a mass spectrometer to analyze hydrocarbon gases picked up in the drilling mud during drilling. The instrument used, a Consolidated Type 21-610 process-monitor mass spectrometer, is shown in the figure.

The mass spectrometer system functions in much the same way as does the conventional hot-wire detector. Drilling mud is passed through a degassifier which removes hydrocarbon gases and vents them into the mass spectrometer. There the gas is analyzed for the light gases which indicate that a gas or oil zone has been drilled. From the gas analysis, potential oil pays can be distinguished from gas zones.

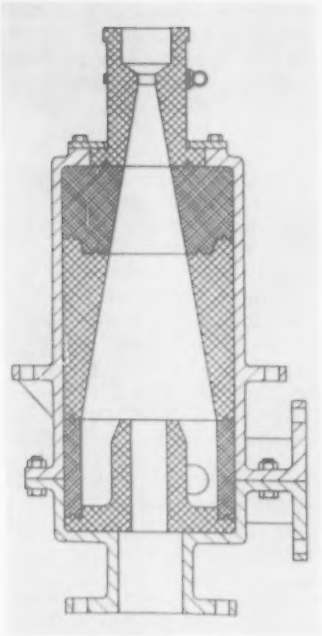
What it is . . . A mass spectrometer is a "molecular sleuth" which bombards samples with a stream of electrons and breaks the material down into ionized molecular fragments. Each compound has a different way of breaking up. The instrument identifies substances by counting the number of fragments of each mass produced. Voltages needed to neutralize the charged fragments provide a quantitative measure of the different components.

The mass spectrometer is extremely sensitive. Under ideal conditions this is about 10 p.p.m. hydrocarbon gas. This compares to the sensitivity of the hot-wire detector of about 400 p.p.m. light hydrocarbons in the gas stream.

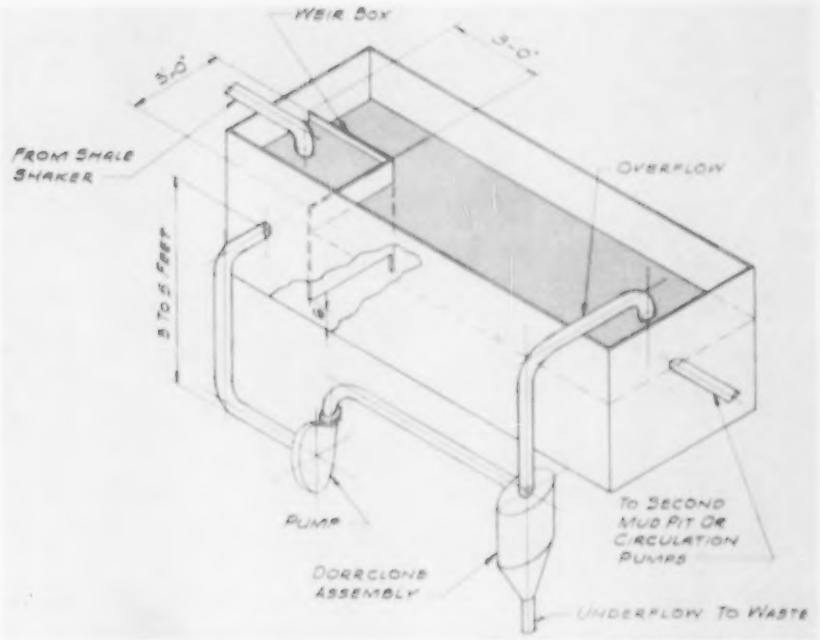
Pay-zone indication . . . Hycalog engineers say that the mass spectrometer is reliable and sufficiently sensitive to indicate that the hydrocarbon zone is being approached, in some cases. However, in order to establish a definite correlation of this condition, they must log several thousand feet of hole.

The mass spectrometer can also be used to analyze the content and composition of hydrocarbons in core samples and in cuttings to determine possible productivity of a formation.

The instrument has been mounted in a mobile laboratory and is taken directly to well sites for logging operations.



THE DORRCLONE unit (Fig. 1)...



...is positioned as above in this sketch (Fig. 2) of the basic setup of a desanding unit.

Experience of Southwest Louisiana operators indicates that . . .

This Mud Desander Cuts Drilling Costs

by D. E. Wuth* and R. L. O'Shields†

A NEW tool is being used successfully to continuously remove sand from drilling mud during drilling operations. The equipment requires very little supervision or maintenance. It will reduce sand volume of muds to about 0.2 per cent.

In Southwest Louisiana wells the desander has saved operators about $2,700 to $3,300 per well. The savings have been obtained in the following ways:

- Longer bit bearing life.
- Decreased drilling time.
- Less pump wear and maintenance.
- Lower repair costs on mud-line valves and swivel washpipes.

*Development engineer, Dorr-Oliver, Inc., and †sales engineer, Salt Water Control, Inc. Paper presented at annual A.A.O.D.C. meeting, September 26-28, Houston, under the original title, "New Mud Desander Cuts Drilling Costs."

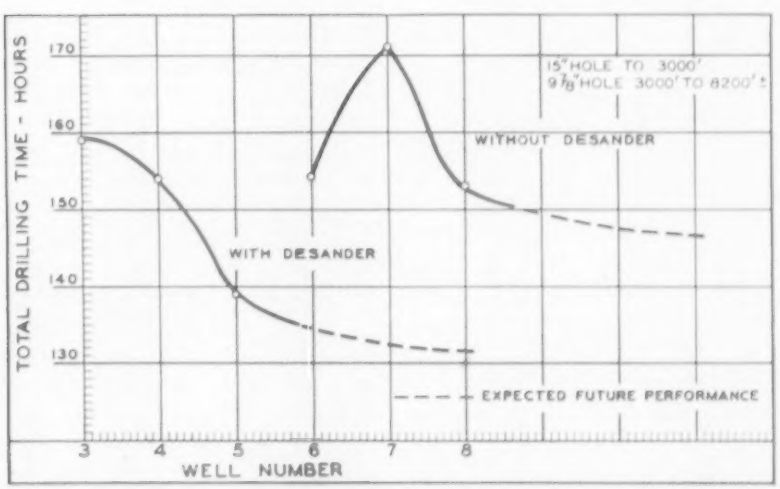


CHART of drilling time required with and without a desanding unit on adjoining wells. Holes drilled by Richardson & Bass' Rig 22, in Calcasieu Parish, Louisiana.

Problem . . . Contamination of drilling fluids by sand, rock particles, and other solids is a serious problem with the drilling industry. These contaminants affect the drilling contractor in two ways:

1. They create serious abrasion problems and maintenance costs to the rig equipment.

2. They increase the problems of controlling such physical properties of the mud as specific gravity, viscosity, and gel strength.

Along the Gulf Coast sand problems are particularly acute and result in excessively high pump-repair costs as well as increased bit wear. The use of shale shakers and settling pits reduces the sand content considerably, but an analysis of the treated mud in the suction pit will often show as much as 5 per cent sands by volume. This con-

dition exists because the mud viscosity and high mud-circulation rates will not permit the fine sand particles to freely settle in the pits.

Many methods and devices have been investigated in the past to solve sand-contamination problems, but none have received wide acceptance because of either economic or design limitations. The present unit achieves the removal of sands by means of a DorrClone (Fig. 1) which is a cylindro-conical liquid cyclone classifying device quite similar to the conventional air cyclone.

Sand thrown out . . . In operation raw mud is introduced tangentially to the top of the DorrClone under pressure. This causes rapid rotation of the mud and the formation of a liquid cyclone with extremely high centrifugal forces. The coarse sand particles are thrown to the walls of the unit and discharged through an adjustable valve at the bottom. The desanded mud stream counterspirals up the interior of the unit and discharges to an overflow manifold for return to the suction pit.

The interior of the DorrClone is formed by five easily replaceable Hycar blocks which have been compounded for abrasion and chemical resistance. There are no moving mechanical parts in the DorrClone; the centrifugal forces developed by the velocity of the mud stream are responsible for the sand rejection.

Fig. 2 shows the basic setup of a desanding unit.. A centrifugal pump sucks mud from the first mud tank after the shale shaker and forces it through one or a battery of desanders.

Rate of mud desanding . . . At the present time desanders are available with either four or six DorrClone units mounted in parallel. The capacity is a function of such factors as feed pressure, size of fittings, mud viscosity, etc., and is in the range of 400 to 500 g.p.m. for four units and 600 to 800 g.p.m. for six units. Normal feed pressures are 20 to 30 psig. which requires either 20 or 35 hp. respectively.

Typical performance is shown in Table 1, where it is seen that the maximum amount of sands observed was 0.2 per cent by volume in the finished mud stream. It can also be observed that the amount of sand remaining in the mud is a function of the dilution of the underflow sands. As the density of the underflow is increased (by restricting the bottom valve) there is a tendency for small amounts of sand to go out the overflow. Within the range of sand contents found in drilling mud, the efficiency of the desander is independent of the sand content in the feed.

Benefits obtained . . . The data in this report are from seven wells drilled since November 1954. A comparative analysis was made of four wells on which the desander was used versus four wells without it in Gillis-English Bayou field, Calcasieu Parish, Louisiana. The greatest distance between any two wells is slightly more than 1 mile and since the geologic strata are virtually identical in each well, it was possible to get a very accurate evaluation of the desander.

In every well drilled the desander has effected large savings on rig time, maintenance, and equipment. This is summarized in Table 2 and discussed in detail as follows:

Rig time . . . In a given field with the same rig and crew it is normal to find that succeeding wells are drilled with less rig time as the crews become more experienced with the conditions of the area. The total drilling time for wells with 9⅞-in. holes is plotted in Fig. 3. It is seen that drilling time was steadily reduced with the desander. Wells later drilled without the desander by the same rig and crew actually increased in drilling time. A comparison of the data shows that the desander saved a minimum of 15 hours of drilling time.

TABLE 1—Typical Performance of the Desander

Per Cent Volume Sand in Mud
(Size greater than 200 mesh)

Feed to sander	Desanded mud to reciprocating pump	Sand rejects to waste
6.00	0.10	80
4.95	0.45	44.5
3.25	0.20	80
2.50	0.00	45
2.50	trace	80
2.25	0.10	76
1.50	trace	45
0.25	0.10	16
0.25	0.10	18
0.20	trace	14
0.15	trace	22

TABLE 2—Direct Rig Savings Observed with the Desander, Gillis-English Bayou Field, Calcasieu Parish, Louisiana. All Wells with Surface Hole to 3,000± ft.

(Total depth 8,200± ft.)

A. With 15-in. Surface Hole and 9⅞-in. Hole Below Surface (3 wells with, 3 without).

Rig time:

A. 15 hours' rotating time saved.	
B. 3 hours' down time saved on pump repairs and washing of suction tank.	
C. Total of 18 hours saved at $50 per hour	$900
Pump parts	1,200
Mud valve and swivel repair parts	350
One 9⅞-in. bit	250
Per well, total direct rig savings	$2,700

B. With 17½-in. Surface Hole and 12¼-in. Hole Below Surface. (1 well with, 1 without).

Rig time:

A. 11 hours' rotating time saved.	
B. 3 hours' down time saved on pump repairs and washing of suction tank.	
C. Total of 14 hours saved at $50 per hour	$700
Pump parts	1,200
Mud valve and swivel repair parts	350
One 17½-in. pilot bit	795
One 12¼-in. bit	313
Per well, total direct rig savings	$3,358

Bits . . . Without the desander drilling and reaming normally wears out one 17½-in. pilot bit per well but with the desander it is possible to use the same bit for at least two wells. On these same wells when drilling 12¼-in. hole from 3,000 to 8,500 ft., it was possible to obtain 19 per cent more feet per bit and 25 per cent longer runs when using the desander.

This resulted in the savings of two rock bits and two fewer round trips. It should, however, be noted that the total drilling times for these sections of hole were equal. Longer runs were possible because the bit bearings did not fail from sand abrasion.

Repairs to mud valves and swivel washpipes . . . Sand abrasion greatly affects the wear life and maintenance cost of mud-line valves and swivel washpipes as shown by the following tabulation:

Repair parts costs for mud valves and swivel washpipes.

With Desander	
Well No. 3	$64.74
Well No. 4	60.35
Well No. 5	181.83
Average, per well	102.31
Without Desander	
Well No. 6	$536.38
Well No. 7	422.33
Average, per well	479.35

Pump parts . . . The following pump-parts costs have been obtained for the wells. Invoices for the other wells were not available when this was written:

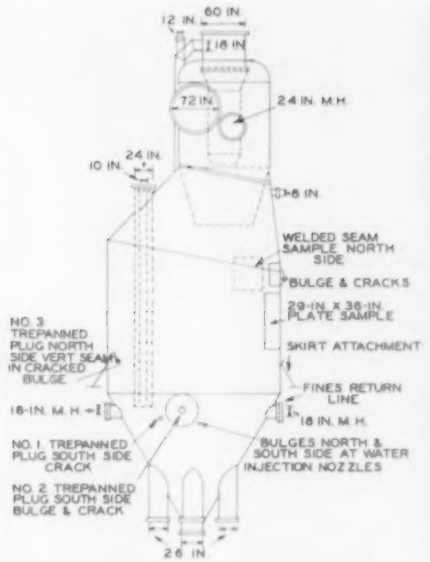
With Desander	
Well No. 3	$122.25
Well No. 4	444.00
Well No. 5	557.48
Average	374.58
Without Desander	
Well No. 6	$2,076.97
Offset of Well No. 5	2,090.21
Average	2,083.00

The above data show that pump-parts life was increased 300 to 400 per cent by the use of the desander.

Intangible benefits . . . Sand bridging is eliminated which permits surface pipe to be run more easily, internal abrasion of drill pipe and tool joints is greatly reduced, galling of tool joint threads by sand is eliminated, and tank cleaning while drilling sandy sections is virtually eliminated.

Acknowledgments

Sincere thanks and appreciation are due the drilling department of Richardson & Bass whose splendid cooperation resulted in the successful development of the desander.



REGENERATED-CATALYST HOPPER for Humble's fluid cat cracking unit, vessel D-11. Fig. 1.

SCALLOP WELD was found cracked at the skirt attachment during one turnaround inspection. The crack extended practically 360° around the vessel. Fig. 2.

Humble's Metallurgical Group—4

Why Did Those Storage Vessels Fail?

This alert trouble-shooting team found out—and studied how to prevent other failures of these fluid catalyst storage hoppers

by F. Lawrence Resen
District Editor

This is the final article in a series of four on the work of the metallurgical group at the Baytown refinery of Humble Oil & Refining Co. Other similar case histories may be found in the three previous installments: Part 1, July 25, 1955, page 211; Part 2, August 8, page 98; Part 3, September 5, page 116.

A DETAILED metallurgical study was made of the regenerated catalyst hopper and spent catalyst vessels at one of the fluid catalytic cracking units.

These vessels failed after several years of operation, and the refinery's metallurgical group made the study to determine cause of failure and how to prevent other failures.

Regenerated Catalyst Hopper

History . . . The fluid catalytic cracking unit was completed in 1942 and began operation in November of that year. The regenerated-catalyst hopper was field assembled after partial shop fabrication. The drum was constructed in accordance with the A.P.I.-A.S.M.E. code. An outline of the vessel is shown in Fig. 1. It was an externally insulated vessel, 20 ft. in diameter by 15 ft. 5 in. knuckle-to-knuckle, with a 3/8-in.-thick shell. The bottom head was a 21/32-in.-thick truncated cone (60° included angle), and the top head was a 7/16-in.-thick frustum.

The drum was supported by a skirt attached to the shell at a distance of 8 ft. 6 in. above the lower knuckle joint. There were five 26-in. outlet nozzles in the bottom cone—two to feed catalyst to the reaction side, one to recycle catalyst back to the regenerator, one to bypass to the regenerator, and one blanked-off nozzle. The cone was fitted with seventy-two 1-in. I.P.S. aeration nozzles for fluidizing the catalyst.

Material used in the vessel shell and head was 18-8 Cr-Ni, Type 304 stainless steel, in accordance with A.S.T.M. Specification A-167-39, Grade 3, requirements. Welding was done with 18-8 Cr-Ni, Type 304 steel electrodes, and the double-butt fusion welded seams were inspected by spot-radiographing and trepanning. The vessel was designed to operate at 20 psig. pressure at 1,075° F. Operating temperature exceeded design conditions during frequent periods of afterburning; operating pressure was approximately 12 psig.

For the first few years, the hopper operated satisfactorily. Trepanned samples taken in October 1945 (after 3 years' service) from the top and bottom knuckle joints revealed no trouble. By April 1946, some difficulty was experienced from catalyst erosion, but more important was the beginning of a long succession of recurring cracks. In October 1946, a crack was discovered in the circumferential weld of the bottom cone. Temporary repairs were made by caulking and welding, and installing a 6 by 24-in. reinforcing pad. subsequently, the crack was chipped out and rewelded.

While the unit was being removed from service in May 1947, a 19-in. crack developed in the lower cone horizontal seam on the west side. Adjacent

piping was found cracked in November 1947, at which time cracks were discovered in the dip legs where they intercept the top cone. By February 1949, the 18-in. nozzle to which the catalyst fines return line is connected cracked at the shell. In June 1951, cracking and bulging of several nozzles necessitated extensive repairs. One 25-in.-o.d., 9/32-in.-thick, 18-8 Cr-Ni, Type 304, steel nozzle was removed from the bottom of the hopper in a badly distorted and cracked condition. Metallurgical examination indicated the failure to be of the mechanical type caused by excessive stress.

In October 1951, catalyst was being charged to the unit after the completion of a turnaround, when a leak was discovered under the vessel skirt. Investigation revealed the shell cracked completely around at the bottom edge of the serrated support, and temporary repairs were made. It was thought that the cracks were caused by excessive bending moments at the top of the skirt. Temperature measurements taken during the next runs indicated that the metal temperature of the bottom cone varied from 500° to 1,050° F. Such temperature gradient resulted in high expansion stresses which are believed partially responsible for the shell failure at the skirt.

Aeration piping and orifice revisions, intended to reduce high temperatures by eliminating catalyst "channeling," didn't improve the situation much. There wasn't enough turbulence to sweep away catalyst insulating the metal surfaces.

Further cracking occurred within less than a month following the repair of cracks adjacent to the skirt. A 16-in.-long by ⅛-in.-wide fissure was found on the south side of the lower cone at a roundabout weld. Water was injected into the cone at a point just above the crack and wet catalyst plugged up the opening, permitting installation of a ⅜ by 8 by 24-in. patch.

The unit ran for another 3 months, when it was brought down for the general inspection and revisions to the unit. Observations made during inspection of hopper and cyclones were:

Hopper . . . The insulation was removed and the vessel sandblasted. Welds attaching one 18-in., one 6-in., and five 26-in.-diameter nozzles were found cracked. Two large bulges were observed in the cones, one on the north side and one on the south side. The shell was found to be badly warped and buckled. The scallop weld at the skirt attachment was cracked practically 360° around the vessel (Fig. 2). After the vessel had cooled, a bulge near the top knuckle on the northeast side cracked (Fig. 3). An area of about 150 sq. ft. on the east side of the shell had eroded to a minimum thickness of ☆ in. (Fig. 4).

BULGE in the hopper cracked after cooling. Fig. 3.

EROSION on the east side of hopper shell covered an area of 150 sq. ft. Fig. 4.

Cyclone . . . The insulation was removed and the vessel sandblasted. Several deep cracks were observed in the flat section of the vessel at the 72-in. nozzle. One crack was found in the top head.

Metallurgical investigation . . . The metallurgical investigation sought to determine the existing condition of the Type 304 shell. Samples (taken at locations shown in Fig. 1) were removed from (1) the plate material and (2) across a vertical weld seam for mechanical testing. In addition, three trepanned plugs containing cracks and a 12 by 12-in. sample from a ruptured bulge were selected for metallographic examination.

These tests were conducted to determine the condition of vessel material:

1. Reduced section tensile tests made on (a) plate material as received and in annealed condition, (b) plate material welded as received and in annealed condition, and (c) existing weld from shell as received.
2. Bend tests made on (a) plate material as received, (b) plate material welded, and (c) across existing weld in shell.
3. Charpy impact tests made on (a) plate material as received, (b) plate material welded, and (c) across existing vertical seam weld.
4. Hardness tests.
5. Strauss tests for susceptibility to intergranular corrosion.
6. Metallographic examination.

Reduced section tensile tests . . . The

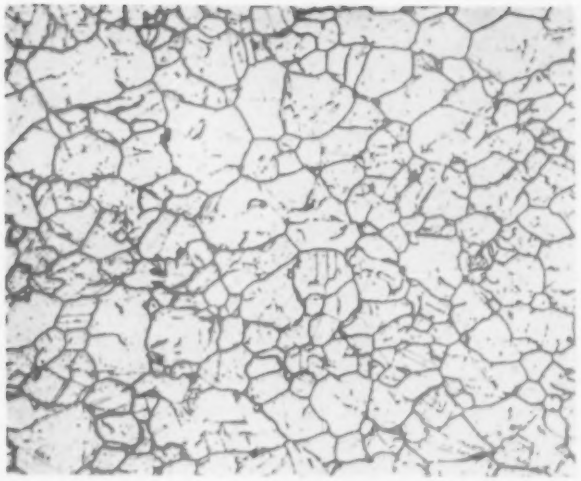
TABLE 1

Specimen No.	Condition	Yield, psi.	Ultimate, psi.	Per cent elongation
1-1	As received	39,000	94,000	50.5
1-2	As received	39,000	92,400	50.5
1-3	As received	37,800	93,100	53.0
1-1W	As received†	45,600	89,900	20.3
1-2W	As received†	41,000	84,300	18.8
1-3W	As received†	39,500	81,200	18.8
1-4W	As received†		90,200	21.8

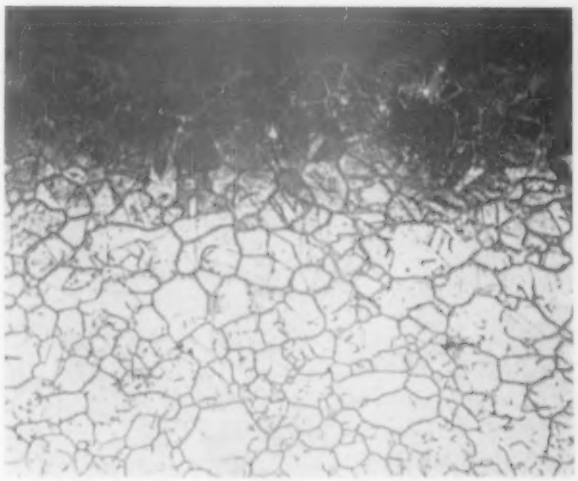
Note: All specimens broke in weld. Several flaws were evident.

Specimen No.	Condition	Yield, psi.	Ultimate, psi.	Per cent elongation
2-1	As received‡	44,700	88,700	21.3
2-2	As received‡	43,400	75,200	*10.9
2-3	As received‡	44,600	92,500	21.9

Note: All samples broke in weld.
*Contained weld defect. †Same plate material welded with 25-20 Cr-Ni, no heat treatment. ‡Welded vertical seam from vessel D-11.



EXTENSIVE CARBIDE PRECIPITATION was found in samples of plate material from the hopper. Fig. 5.



INSIDE SURFACE of hopper showed slight carburization. This was determined from samples of plate material. Fig. 6.

ultimate strength of the vessel material, strength of welded joints, and strength of repair welds were considered of paramount importance. Accordingly, test specimens were prepared from plate material as received; plate material as received, butt welded with 25-20 Cr-Ni electrodes; and an existing weld from a vertical seam of the vessel. Results of these tests are in Table 1.

Researchers wanted to know the mechanical properties of the annealed material for comparative purposes. Therefore specimens were annealed for 1 hour at 2,000° F. and air cooled. A closed container was used to lessen oxidation of specimens. A metallographic specimen was prepared on the annealed material to confirm the re-solution of precipitated carbides. The data are recorded in Table 2.

Bend tests . . . Bend tests were conducted in order to determine if a quick evaluation of the metal condition could be made in this manner. The bend test results obtained are in Table 3.

Impact tests . . . Room-temperature impact tests were conducted to determine to what extent the plate and welds had deteriorated in shock resistance. Keyhole Charpy specimens were employed. Results are tabulated in Table 4.

Hardness tests . . . The following hardness readings are representative:

Plate material	172 BHN
25-20 Cr-Ni weld	190 BHN
Weld metal from vessel	189 BHN

Strauss tests . . . Strauss tests were conducted to determine the susceptibility of the material to intergranular corrosion. This test consisted of exposing samples of the plate material and welded samples from the vessel to a boiling solution containing 10 per cent sulfuric acid and 3 per cent copper sulfate for 72 hours. Exposed samples were then bent 180° in a jig and the results obtained are in Table 5.

Metallographic examination . . . Several specimens were prepared from plate material as received, plate material annealed at 2,000° F. and air cooled, and trepanned plugs through cracks. Observations made from these specimens are:

1. The plate material as received contained extensive carbide precipitation (Fig. 5) and slight (0.002 in.) carburization on the inside surface (Fig. 6). The outside surface showed shallow (about 1 grain deep) intergranular penetration which appeared to be corrosion or oxidation or both.

2. Annealed structures were equiaxial, free from precipitated carbides.

3. Specimens from trepanned samples containing cracks, both in plate

TABLE 2

Specimen No.	Condition	Ultimate, psi.	Per cent elongation
1-1A	Annealed plate	73,500	71.9
1-2A	Annealed plate	87,100	64.1
1-3A	Annealed plate	69,100	67.2
2-1A	Plate containing original weld	76,000	57.8
2-2A	Plate containing original weld	77,900	60.9
2-3A	Plate containing original weld	77,400	62.5

TABLE 3

Material and description—	No. of tests	Results
Plate as received:		
Outside in tension	2	Satisfactory, bent 180°
Inside in tension	2	Satisfactory, bent 180°
Plate welded at 25-20:*		
Root bend	2	Satisfactory, bent 180°
Face bend	2	Satisfactory, bent 180°
Welded vertical seam from vessel*		
Root bend	2	Satisfactory, bent 180°
Face bend	2	Satisfactory, bent 180°

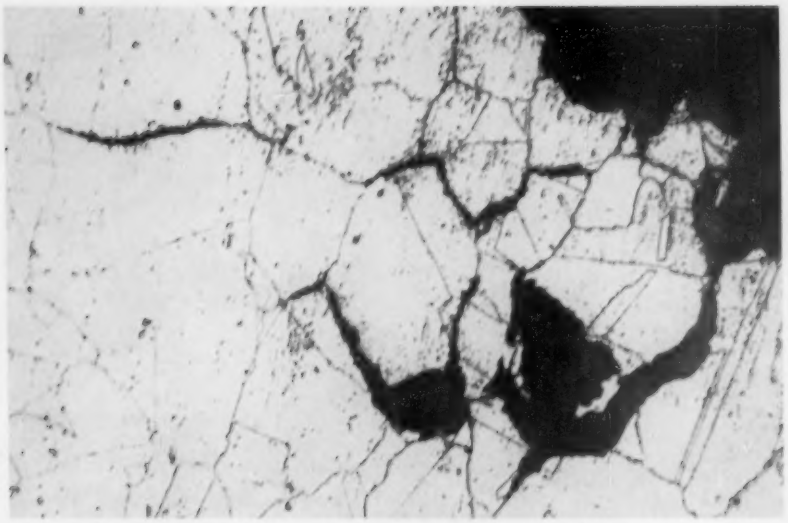
Note: Specimens marked (*) contained welding defects but were of acceptable quality.

TABLE 4

Specimen No.	Condition	Impact strength (ft.-lb.)
1	Plate as received	52, 54, 62
1-A	Plate annealed	138, 140, 137
1-W	Plate material welded with 25-20 notch in weld metal	28, 30, 28
1-WA	Same as 1-W but annealed	60, 60, 63
2	From original weld in vessel seam, notch in weld metal	11, 10, 11
2-A	Same as 2 but annealed	96, 90, 64

TABLE 5

Sample	Description	Results
1-1	⅜ by 1 by 6-in. plate material	Bent 180° but "sugared" ⅛ in. deep
1-2	⅜ by 1 by 6-in. plate material	Bent 180° but "sugared" ⅛ in. deep
2-1	⅜ by 1 by 6-in. strip, center weld	Bent 180°, plate "sugared," weld OK
2-2	⅜ by 1 by 6-in. strip, center weld	Bent 90°, plate "sugared," weld failed



HOPPER CRACKS were intergranular and filled with oxide scale. Fig. 7.

and adjacent welds, showed a definite tendency for the cracks to begin on the outside surface in the shallow fissures previously described. Cracks without exception were intergranular and filled with oxide scale (Fig. 7).

Conclusions . . . These observations were made during this investigation:

1. Cracks were invariably located in areas demonstrating severe plastic flow manifested by bulging, wrinkling, corrugating, or similar distortion.

2. Unpredictable vessel or line movements were frequently observed and believed at least partially due to extreme thermal gradient measured on the vessel wall.

3. High metal temperatures from afterburning were evidenced by temperature measurements and metal color (dull red). It was believed that metal temperatures of 1,500° F. or greater were obtained, resulting in carburization of the inside surface, intergranular oxidation of the outside surface, and severe distortion.

4. Cracks occurred both in plates and adjacent welds, and were invariably associated with vessel distortion. Cracks originated at shallow fissures on the outside surface.

5. The vessel plate tested had an ultimate strength of 93,000 psi. with an elongation of 51 per cent. Brinell hardness was 172.

6. Plates containing original welds had an ultimate strength of 85,500 psi. and an elongation of 20.5 per cent. Failure was through the welds.

7. Plate and welded bend tests were satisfactory indicating that the material could be welded.

8. Welded repairs would be seriously complicated by bulges and wrinkles on the shell.

9. Room-temperature impact strengths were satisfactory on the plate material, but the impact strength of the welds was low.

10. Strauss tests indicated that the vessel material was susceptible to intergranular corrosion.

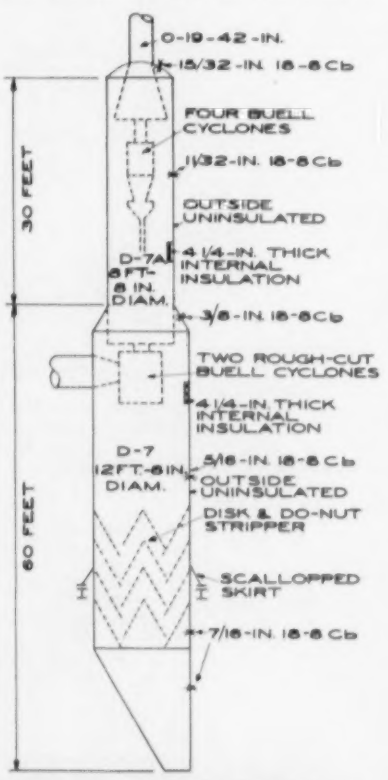
Spent Catalyst Vessels

History . . . The spent-catalyst hopper and the spent-catalyst stripper were of original unit construction. A dimensional outline is shown in Fig. 8. Material was columbium stabilized, 18-8 Cr-Ni stainless steel, Type 347.

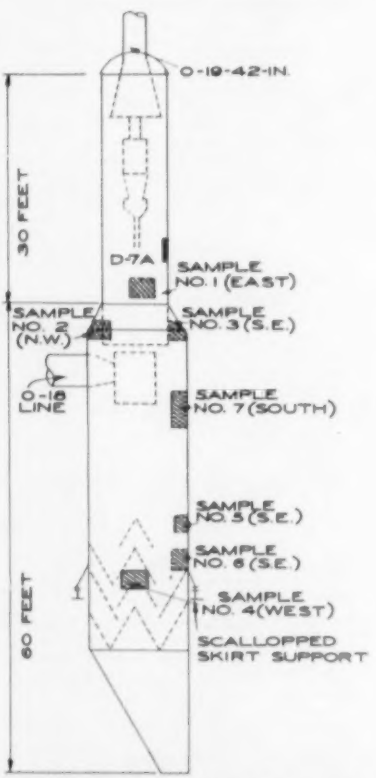
From the completion date in December 1942 to February 1950, the vessels were operated with external insulation (inside surface bare) at an internal fluid temperature of 875°-950° F. Only minor mechanical difficulties were experienced during this period—the principal ones being expansion difficulties with the attached piping and erosion which caused several shell leaks. In February 1950, an insulating liner was installed. The object of the liner was to minimize or eliminate erosion and expansion difficulties. Hence, for the next 2 years, the shell temperature was quite low, frequently below 200° F. although the fluid temperature remained at 875°-950° F.

On May 28, 1951, a 5-in.-long crack occurred under the support skirt of D-7 after a unit down time. A trepanned plug was cut from the crack which was repaired with an overlay welded patch. Metallurgical examination of the sample showed that although the material was columbium stabilized, extensive intergranular carbide precipitation had occurred and failure was intergranular and through the carbide.

On June 25, 1951, 38 cracks were

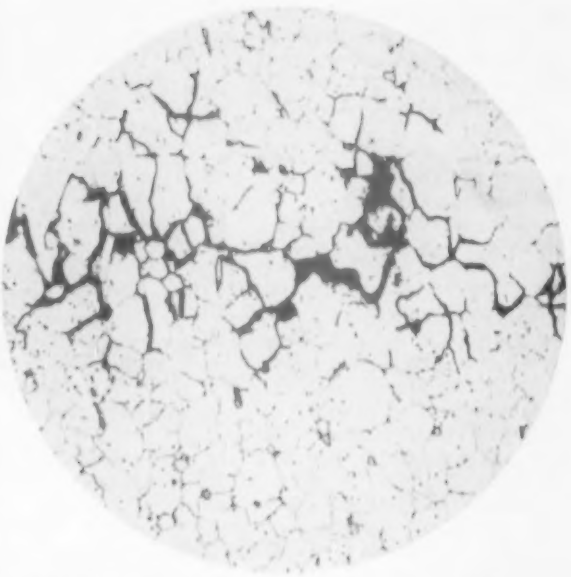


SPENT CATALYST VESSELS installed at Humble's fluid cat cracking unit. Fig. 8.



VISUAL EXAMINATION of these samples showed association of cracks with liner attachment. Fig. 9.

MANY STUD WELDS were circumscribed by cracks at various stress levels. Fig. 10.



NUMEROUS CRACKS were observed in areas of high stress—particularly around studs supporting internal liner. Fig. 11.

in a narrow circumferential band adjacent to the scalloped skirt attachment. Others were scattered virtually from one end of the vessel to the other. A 12-in.-wide "strap" was welded on above the skirt attachment and overlay patches installed on random cracks.

The cracking epidemic continued until the total count approached 100. At one time, a ¼-in.-thick external carbon steel "wrapper" was considered, but patching was successful and the down time delayed until March 1952, when modification of the existing reactor was scheduled. Replacement was made with a vessel of a new design. Carbon steel was used in its construction.

Metallurgical investigation . . . No sample material (except the one trepanned plug mentioned above) had previously been available for metallurgical test work. In order to conduct a thorough investigation, adequate samples were selected before the vessels were disassembled (for locations, see Fig. 9). The following observations were made during operation and after disassembly:

1. Some vessel plates showed no cracks.

2. Plates that were cracked generally contained several.

3. Condensation evidently occurred behind the liner since leaks were generally manifested in fine liquid sprays or seeps. While it was impossible to catch samples, this leakage was believed to be water since steam was used for stripping.

4. Cracks generally appeared following down times when unusual "warming up" stresses were applied.

5. Cracks were from the inside out, frequently observed "growing" from a pinpoint to an appreciable crack in a few minutes.

6. Cracks were associated with the flash welded studs which supported the liner. This was apparent before disassembly by the geometric patterns on the shell and afterward by a visual examination. Other cracks occurred at points of internal support attachment, fillet welds of patches, and other points of high stress.

7. The inside surface under the liner was covered with a fine, dark, "sooty" sulfide scale.

8. The hexagonal carbon-steel reinforcement in the liner and the wire reinforcement were coated with a similar black scale.

Hence, it was indicated before disassembly that cracking was associated with the liner. This was partially based on visual observations and experiences of 0-17 and 0-18 lines on the same unit. These lines, originally Type 304 stainless steel with carbon-steel wear plates, were replaced with Type 347 (columbium stabilized) stainless steel with an insulating liner reinforced with carbon-steel grating. Both installations failed at stressed points in contact with carbon steel. Association of the cracks with the liner attachment was apparent after visual examination of the samples shown in Fig. 9. Many stud welds were circumscribed by cracks at various stress levels as well as radiating cracks (Fig. 10).

Two generally acceptable explanations were offered as to why some plates cracked and others did not: (1) It was a matter of susceptibility to intergranular cracking resulting from the failure of the carbide stabilizer to function as intended, or (2) it was the difference in the magnitude of the applied stresses. Consequently, a test was initiated with these objectives:

1. To determine the primary cause of the failure.

2. To determine if preferential cracking was a matter of susceptibility or stress concentration.

Outline of tests . . . Reduced section tensile tests were run on both cracked plates and sound plates. Bend tests and hardness tests were also run on both cracked plates and sound plates.

Strauss tests for susceptibility to intergranular corrosion were run on cracked plates as received and stressed (bent), and on sound plates as received and stressed.

Chemical analyses to determine difference in composition and metallographic examinations were also made.

Mechanical tests data . . . Samples 2 and 3, from the top cone, were selected for investigative purposes. This selection was made because of similar location on the vessel and apparent difference in susceptibility to cracking. Sample 2 contained no patches, while Sam-

TABLE 6

Sample No.	Plate	Ultimate strength (psi.)	Per cent elongation
2-1	Sample 2	91,000	50.0
2-2	Sample 2	91,400	50.2
2-3	Sample 2	89,600	50.2
3-1	Sample 3	95,800	50.0
3-2	Sample 3	94,700	48.5
3-3	Sample 3	96,000	46.9

ple 3 contained six. Reduced section tensile test specimens were prepared from both plates and broken. The results obtained are in Table 6.

Bend tests were conducted on specimens from No. 2 and sound areas of No. 3. All specimens were capable of bending 180° without evidence of failure. Hardness tests showed plate No. 2 to have an average hardness of 156 BHN while plate No. 3 averaged 169 BHN.

Intergranular cracking . . . The standard Strauss test was selected as a method of determining the degree of susceptibility to intergranular cracking. This solution is capable of attacking 18-8 Cr-Ni steel in which "sensitization" has occurred through the precipitation of chromium carbides in the grain boundaries. Attack occurs at the grain boundaries because the carbon (normally in solid solution with the iron, chromium and nickel) precipitates in the grain boundary as chromium-carbide, consuming large quantities of chromium from localized areas. The impoverished area therefore lacks sufficient chromium to resist attack by acidic solutions.

Stress acutely accelerates cracking in such weakened steels and end results have been termed "intergranular corrosion cracking." Additions of columbium (to the extent of 10 times per cent of carbon, 1 per cent Cb maximum) reduce the susceptibility of intergranular cracking since columbium has a greater affinity for carbon than does chromium and the carbides formed are columbium carbides rather than chromium carbides. However, experience has shown that "stabilization" by such carbide formers is not entirely effective.

To determine the effects of stress on cracking, ⅜ by ¾ by 6-in. strips from plate No. 2 and plate No. 3 were stress relieved 1 hour at 1,250° F. to eliminate the effects of previous deformations. Two samples of each plate were bent 60° while others were unstressed. Samples were boiled 72 hours and bent 180° over a 1-in.-diameter pin. The results obtained are in Table 7.

TABLE 7

Sample No.	Type	Results
2-1	Unstressed	Some weight loss*
2-2	Unstressed	Some weight loss*
2-1S	Stressed	Some weight loss*
2-1S	Stressed	Some weight loss*
3-1	Unstressed	Some weight loss*
3-2	Unstressed	Some weight loss*
3-1S	Stressed	Shallow cracks on tension side
3-2S	Stressed	Bent 180° without complete failure

*No evidence of intergranular attack.

From these tests, it was deduced that:

1. Neither plate was highly susceptible to intergranular corrosion.

2. Although not measured, it was evident that samples from No. 3 plate suffered greater weight loss than those from No. 2 plate.

3. Stressed specimens from No. 3 plate developed cracks upon bending while unstressed specimens did not. This indicated that stressing accelerates intergranular corrosion in No. 3 plate.

Spectrographic analyses confirmed the presence of columbium in both plates. There was no discernible difference between the amounts of columbium in the two plates.

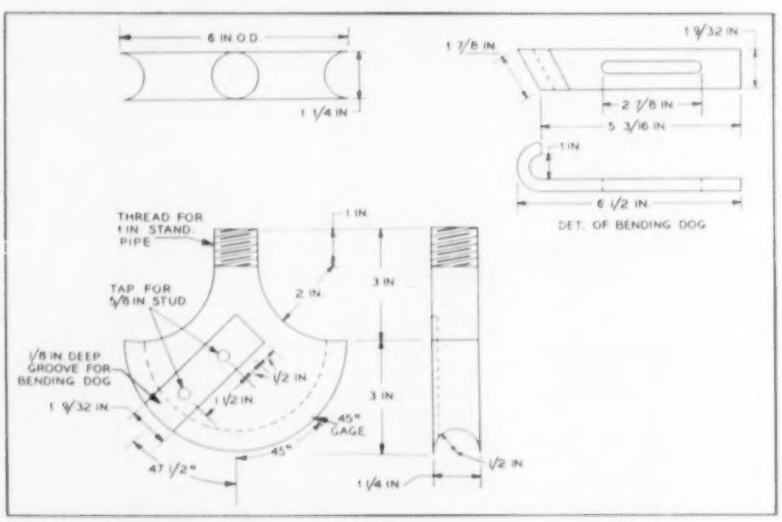
Metallographic examination . . . Metallographic specimens were prepared from the sample plates and examined. Microstructures were typical of austenitic stainless steels containing precipitated carbides. Numerous cracks (Fig. 11) were observed in areas of high stress—particularly around the welded studs supporting the internal liner. Cracks were invariably an intergranular network originating on the inside surface. Specimens from plates Nos. 2 and 3 were examined and found similar in microstructure. Plate No. 2 contained a larger grain size and less grain-boundary carbide than plate No. 3.

Conclusions . . . The data obtained during this investigation served as a basis for these conclusions:

1. Failure was by intergranular cracking in areas of highest stress. Based on experimental work, failure was due to stress corrosion cracking by sulfurous and sulfuric acids. These were formed by the hydrolysis of iron and nickel sulfide scale developed on the plate material and carbon-steel reinforcement during operation and were hydrolyzed during down times. Cracks generally appeared following down time when unusual "warming up" stresses were applied.

2. Strauss tests of stressed and unstressed specimens from two plates, No. 2 (uncracked) and No. 3 (cracked) indicated that neither was particularly susceptible to intergranular corrosion. However, stressed Strauss specimens of No. 3 plate cracked upon bending while those from No. 2 plate did not, indicating that cracking was a matter of susceptibility.

3. Mechanical test results showed both plates to have excellent properties. Tensile strength and hardness were somewhat higher than normal, but ductility was excellent. Plate No. 3 consistently showed higher hardness values and tensile strength. This can be attributed to a smaller grain size and a greater amount of precipitated carbides.



You Can Make This Pipe Bender in Your Own Shop

A PIPE bender which will quickly and accurately handle ¾ and 1-in. pipe may be machined easily in any plant shop.

The bender has a grooved, semicircular bottom half.

A slot to accommodate the bending dog is cut into side of the dog.

The dog itself is a J-shaped piece of tool steel, 1⅛ in. thick and 1 9/32 in. wide.

To use the bender, the dog is fastened in position, the pipe to be bent placed so as to rest in the "J" and the grooved bender. Then leverage applied by means of a 1-in. pipe attached to the threaded stem. Uniform bends may be rapidly made by using this tool.

Case History . . . Here's the economics of

Cathodic Protection of Tank Bottoms

Stray currents and a cinder fill complicated protection of two storage tanks dealt with by the author's company. But planning the protection system before the tanks were built allowed burying anodes and reference electrodes beneath the tank, greatly simplifying the problem. Tests showed the null-circuit method was the only one capable of establishing the true amount of cathodic protection current required.

by J. J. Meany, Jr.
A. V. Smith Engineering Co.

IN corrosive environments, cathodic-protection systems for the earth sides of storage tanks can definitely save money. To be most effective the system should be designed before the tank is built. This allows placing ground bed and reference electrodes beneath the tank.

Correct determination of the current necessary for protection requires using null circuit techniques and electrodes beneath the tank. Other techniques give erroneous results. The above conclusions are confirmed by studies made on two oil tanks and their corrosion-control system, as described here.

The two oil tanks are located in a gas-production plant that has experienced corrosion failures in tank and holder bottoms and underground piping. This corrosion has resulted in the necessity for plant replacements and the loss of raw materials and manufactured product. A comprehensive corrosion-control program is now in progress.

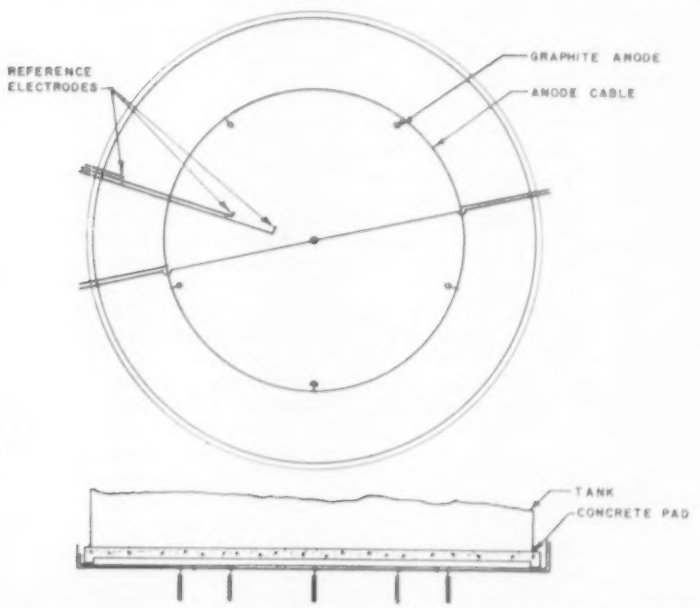
Stray-current control . . . A general study of characteristics and magnitude of stray currents was the initial phase of this program. Stray direct currents, the result of electric-railway operation, were flowing on interconnections between the plant and the city network. Gas and water mains, and electric and telephone cables were conducting these currents. Some of these conductors carried traction current into the plant 100 per cent of the time where it then flowed from plant structures to earth, causing loss of metal from the plant structures. Insulating joints were installed to block the flow of current into the plant resulting in a large reduction in plant corrosion rate.

One major pipeline serves as sole supply of natural gas to the plant for processing and redistribution. This pipeline is protected from corrosion by a bond to a d.c. substation of the traction system. An insulating joint had been installed in the pipeline at the point of entry into the plant.

As a result of design tests conducted, a current-limiting resistor was installed across this insulating joint. This resistor allows a calculated amount of current to flow from the plant, eliminating any detrimental effects that could be caused by stray traction currents bypassing through the earth.

A comprehensive soil-resistivity survey was next conducted throughout the entire plant. The resistivity values obtained serve as an index of relative corrosiveness of soils in various parts of the plant. The soils range from moderately corrosive to extremely corrosive.

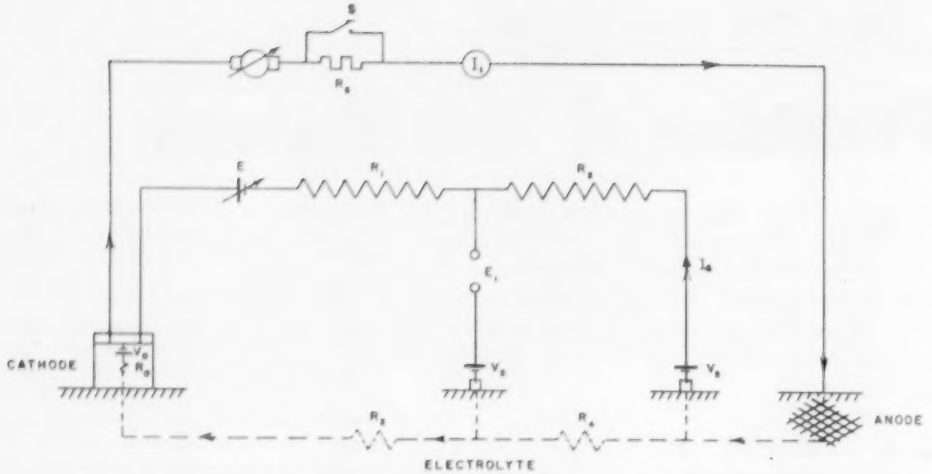
The history of the plant's corrosion failures prior to initiation of a general control plan included penetration and deep pitting of tank and holder bottoms, and pipe-wall failures. One oil-storage tank, recently removed from service for inspection, had many penetrations of its bottom, largely the result of corrosion from the earth side. This tank had been constructed on a concrete foundation with an overlaid sand pad. Infiltration of corrosive media from the surrounding soil had resulted in contamination of the sand pad. The amount of corrosion on this tank bottom undoubtedly will result in the necessity for complete replacement. A large expense will result from the extended shutdown time and replacement.



POSITIONS OF ANODES and electrodes is shown in this plan and profile view of one tank. **Fig. 1.**

Tank Design Includes Protection System

Consideration of these experiences led to the obvious conclusions that a system of corrosion control on tanks would be of large economic benefit. Therefore, when construction of a new tank was proposed, a cathodic-protection system was included in original design. The location of the proposed tank was an area where soil resistivity is as low as 300 ohm-cm. The surrounding environment consists largely



LEGEND FOR FIG. 2

V_c = polarization potential of cathode
R_c = surface resistance of cathode
E_1 = potential difference at "null" indicator
V_2 = potential of nearer reference cell
V_3 = potential of farther reference cell
E = backing out voltage
I_1 = externally applied current
I_2 = bridge operating current
R_1 = adjustable resistance, external bridge
R_2 = adjustable resistance, external bridge
R_3 = apparent resistance, nearer reference cell to cathode
R_4 = apparent resistance between reference cells

SCHEMATIC OF THE NULL CIRCUIT used in finding required amount of cathodic protection current. Fig. 2.

of artificial fill, including rubble, cinders, and spent oxide with a pH as low as 2.0.

A factor of concern in design was also the possibility of damage from stray direct currents. Although the previously described program of controlling stray traction current had resulted in a reduction in its general detrimental effects, the presence of some measurable stray currents was to be expected.

Because of safety and practical factors, insulating joints were not used to electrically segregate the proposed tank from the remainder of the plant. The joints, if installed, would be partially electrically short-circuited by the grounding and conduit of lightning systems. There would also be an incipient hazard caused by the limitation of grounding paths for possible lightning strokes or insulation failure.

With the electrical configuration thereby presented, it was expected that there would be effects of not only stray traction current flow but also of the flow of galvanic current. The galvanic current flow would be generated by the dissimilarity of surface conditions between existing underground plant and a newly constructed bottom. Electrical connection of metals with the surface conditions presented would result in a flow of current from the new metal with accompanying electrodeposition of metal from the tank bottom.

During the early stages of tank design, plans were also begun for the construction of a second tank, physically adjacent to the first and nearly identical in construction details. This close physical proximity and short time interval between construction dates afforded the opportunity for the comparison of protective-coating techniques.

Coating for tank bottoms . . . The application of a chemically inhibited cold-applied wax coating to bottom plates had been a standard practice in the past. The electrical-resistance qualities of this material is very low when compared with those of hot-applied coal-tar enamels, therefore would have little influence on the current required for cathodic protection.

The surface of the applied wax material is soft. Cinders and debris tend to stick to this surface when they come in contact with it. The soil at the plant, as noted, consists largely of conglomerate fill and spent oxide. It has been noted in the past that some of these materials almost invariably come in contact with the coating when it is field applied. This presents a serious problem, since a cinder in contact with a bottom plate will form an aggressive corrosion cell. Cathodic-protection currents are often shielded from this cell by the electrically conductive cinder.

A hot-applied plasticized coal-tar enamel has a high enough electrical resistance to greatly reduce the amount of current required for cathodic protection of surface. The material sets as soon as it cools, reducing the hazard of wind-blown debris being included.

How will current distribute? . . . It was apparent that a coating of relatively high electrical resistance applied to the under side of the tank's bottom plates would reduce the cathodic-protection current required per se. It is not possible to predict the effects that protective coating will have on the distribution of the cathodic protection currents under these conditions.

It was conceivable that the resistance to current flow path through earth from the anode system directly to the tank bottom would be increased. This would increase the percentage of current that would flow from the ground bed through earth to other grounded plant structures, then returning to the subject tank over conductive metal paths provided by interconnecting piping. The reduction of **total** current requirements could therefore not be predicted. Whether the use of protective coatings would save money was therefore somewhat in doubt. The intent in reducing protective-current requirements was chiefly to reduce interference effects on other underground structures. Reduction in power consumption due to lower current requirements was not a factor for consideration in this instance.

To obtain comparative data, the material applied to the plates on one tank was a cold-applied inhibited wax. The application cost of this material was small. The plates of the second tank received an application of hot-applied plasticized coal-tar enamel. All plates were coated to within 6 in. of the edges. The uncoated area was left to make welding easier.

Ground bed . . . Since the protection system was included in original design of the holder, it was possible to locate the ground bed for the protective system beneath the tank bottom. In this manner the most favorable conditions for the confinement of applied currents to the desired area was presented.

An interesting construction detail developed in this instance: The ground bed selected was one of graphite anodes with distribution as shown on Fig. 1. The tank itself was to be constructed on a foundation of steel-shell concrete piles. The anodes were placed between these piles. It was found convenient during construction to drive piling casings, at the anode locations, to the designed depth. This casing was then cut off at ground level, the anode

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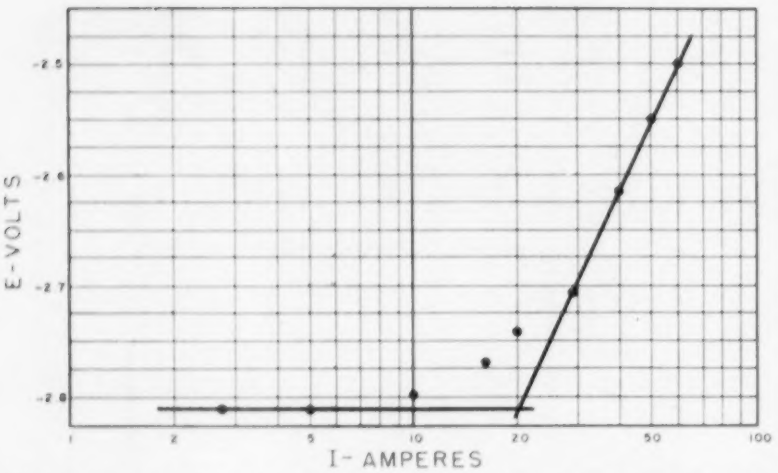

POLARIZATION CURVE used to pick minimum amount of current for complete protection. Fig. 3.

centered in it and coke breeze tamped.

Connecting leads were installed immediately following the piling installation and leads brought out to the edge of the proposed concrete pad. The pad was then poured, leaving leads and anodes in a position protected from accidental damage and in close physical proximity to bottom plates of the tank.

Three reference electrodes as shown in Fig. 1 were also included in this stage of construction. These electrodes were placed in the area that geometry showed would be the points of minimum overlap of current delivered from the anodes. These electrodes directly observe those portions of the holder bottom most difficult to protect against metal loss. The determination of exact cathodic protection current requirements was thereby insured.

Test Results

Galvanic currents . . . Prior to the installation of lighting circuits on one tank, measurement was made of currents flowing on interconnecting piping to the tank. These measurements showed that a total of 1.03 amp. was flowing from the tank bottom to earth.

As this current was primarily galvanic it would result in the electrodeposition of slightly over 20 lb. of tank bottom each year. This current flow was the result of the difference in surface conditions of the new tank plates and the generally oxidized plant structures. This data was obtained on the tank bottom coated with wax.

Current requirements . . . Measurements on the tank with wax-coated plates showed that 24.9 per cent of current delivered by the ground bed flowed to other structures and returned over interconnecting piping to the tank. Construction procedures did not allow similar measurements on the tank with coal-tar-coated plates. It is obvious, however, that even with a ground-bed system in close arrangement with the tank bottom, appreciable applied current will flow directly to other underground plant. A measure of cathodic protection will be afforded this property.

No underground structures owned by others were affected by this system due to the close physical arrangement of ground bed and tank bottom.

The current values required for cathodic protection of the tank bottoms were determined by hydrogen-overvoltage polarization tests. The basic instrumentation was based on "null" type measurements developed by the late Dr. J. M. Pearson. This technique was selected because long experience with its field applications has shown that the results obtained are accurate and in agreement with theoretical considerations.

Corrosion of an underground structure occurs when there is an energy transfer in the form of positive metal ions migrating from structure to environment and positive hydrogen or salt ions returning to the structure at different points. Complete cathodic protection must prevent the flow of positive metal ions to the environment.

It is obvious that if the positive ion transfer at all points on the structure was zero, or from environment to structure, no metallic ions can go into solution. The criteria for minimum cathodic-protection currents, to be accurate, must be based on the determination of the amount of applied current required to realize this condition.

Criteria based on secondary phenomenon or rule of thumb are certain to be, except for accidental cases, in error. Sometimes the error will be without significance. But at other times the error will result in a major difference and failure of the design to completely mitigate corrosion of the tank bottom.

The system of measurement used on the oil tanks allows direct observation of electrochemical phenomenon associated with reactions occurring when enough current is applied externally to eliminate corrosion. The potential expressed by a corroding structure, neglecting stray direct-current effects, will remain constant as limited cathodic current is impressed upon it. Where the impressed current is large enough to completely eliminate corrosion, the potential of the structure will vary as a direct function of the $\log_{10}$ of the current.

Transient effects occur between these two states. The intersection of straight lines graphically determined by semi-log coordinates occurs at the minimum value of current required to eliminate corrosion.

A difficulty occurs in the field in trying to measure structure voltage. Since a reference electrode in the environment must be used, any voltage observed while current is impressed will consist of at least three parts: (1) reference cell voltage; (2) structure voltage; (3) the voltage (IR) caused by the the tank bottom coated with wax.
flow of impressed current through environment and structure surface-film resistances.

Accurate observation of the change in structure voltage (2) necessarily requires the elimination of the IR voltages (3). This may be done by the measurement of R for each value of I, and the subtraction of the product from the observed voltage. But this results in comparatively large probable errors.

Description of circuit used . . . The null circuit results in the elimination of the extraneous voltage by the balance of a modified Wheatstone bridge. The circuit used is shown in Fig. 2. A convenient means is provided for the measurement of changes in the true electrochemical voltage of the structure being investigated.

If **variable** stray-current effects are negligible, this structure voltage, $V_{...}$

THE AUTHOR

J. J. Meany, Jr., has been actively engaged in corrosion control work for 7 years, having been with Texas Eastern Transmission Corp. and Transcontinental Gas Pipe Line Corp. For the last 3 years he has been with A. V. Smith Engineering Co., of which concern he is vice president. He studied electrical engineering at University of Pennsylvania, and mechanical engineering at New York University.

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will remain essentially constant. If external current is impressed from an established ground bed through earth to this structure, the voltage, V_o, will remain constant until polarization films, initially hydrogen, are deposited on the structure. When the entire structure is polarized V_o will vary as a logarithmic function of the impressed current I_1. Impressed current and the change in V_o, are measured simultaneously, at equally timed intervals, with uninterrupted periodically increasing amounts of current.

The observed values are plotted on semilogarithmic coordinate paper. Two straight lines will result. One line is determined by values before measurable polarization occurs and one after polarization is complete. The intersection of these two lines occurs at the exact value of current required for the cathodic protection of the structure.

How circuit works . . . The problem of measurement of V_o or its variation is solved by the circuit shown in Fig. 2. The measurement of a structure voltage by use of a single reference cell, say the nearer cell, V_2, would necessarily result in the inclusion of the voltage $(I_1 - I_2) \times (R_3 + R_o)$ together with the value of V_o desired. Since $(R_3 + R_o)$ will vary, the two components could not accurately be separated by present field techniques.

The null circuit uses a second reference cell, V_3. If the variable resistor $R_1 + R_2$ is adjusted so that $R_1 : R_2 = R_3 : R_4$ no deflection will be noted on the null indicator E_1, for increments of I_1 of reasonable duration. If the voltage at E_1 is adjusted to zero by the backout voltage E, E will be equal to V_o if $V_2 = V_3$. Extraneous voltages caused by the flow of impressed current through environment and structure surface-film resistances will thereby be eliminated.

In field practice R_5 is adjusted to be equal to about 0.1 of the resistance of the complete anode-cathode circuit. The generator is adjusted to an output known to be well below that required to polarize the structure. Switch "S" is opened and closed and the variable resistor $R_1 + R_2$ is adjusted until no resulting deflection is noted at E_1. After a timed interval E_1 is adjusted to zero, at E, and the values of I_1 and E recorded. I_1 is then increased at predetermined increments and the procedure repeated.

Note the significantly less current required to protect the tank with coal-tar-coated plates. Also note that a correct evaluation of current required for protection is not obtained from a so-called remote electrode.

The interpretation of the current-requirement tests requires the correct definition of the field influencing the measuring-electrode potential. The extent of this field has been shown to be that included in a 120° angle from the observing electrode when the structure has no protective coating. This field is increased where effective protective coating has been applied. The results obtained by electrodes beneath the tank could be duplicated by the use of an external electrode placed in an augered hole deep enough to insure that the center of the tank bottom was observed. The values obtained by this method might be larger than the minimum required for tank-bottom protection if adjacent structures are necessarily in the field of the electrode.

Test results . . . A typical null curve obtained on Tank A is shown on Fig. 3. This curve was obtained using the "outer" reference electrode. Note that no measurable polarization occurs until 10 amp. is applied. Increase of currents over 30 amp. results in a logarithmic change in structural potential.

The intersection of two lines, one determined by points previous to polarization, the other by points after polarization, occurs at the minimum value of current required to protect that portion of the structure observed by the reference potential electrode. Points not falling on either line are the result of transient conditions occurring while polarization is only partial.

At the start of the test run the absolute value of the potential of −2.807 volts results from the difference in voltage between reference electrodes V_2 and V_3 and steady earth currents flowing between the electrodes. V_3 is a copper-copper sulfate electrode, while V_2 is a steel rod. These voltages are magnified in E due to the fact that $R_1 + R_2 \neq 1 \times 10^6$ ohms.

If the bridge balance requires that $R_1 \neq R_2$, the voltage E, required to back out a steady voltage at the null indicator caused by a voltage between V_2 and V_3, may be larger than the voltage between V_2 and V_3 due to losses in the high-resistance circuit.

Since results are based on the **change** in E, the absolute voltage between cells or between cell and structure has no effect on the results obtained. This is a basic difference from other types of criteria and eliminates a frequent source of error. Since V_3 is required to pass current necessary to operate the Wheatstone bridge circuit without a significant polarization, it was necessary to use a specially designed copper-copper sulfate electrode rather than a steel rod as V_2. V_2 is connected to a vacuum-tube voltmeter, therefore, is not required to pass significant current. Sufficient time had passed from installation to assure that this steel rod was of a stable voltage.

Further tests conducted on the wax-coated tank bottom show a comparison of various common criteria used for the determination of minimum current requirements:

Criteria—	Cathodic protection current requirement (amp.)
Null curve	20.5
0.85 volt to copper-copper sulfate	110
0.4 volt to steel	139

Under some conditions the rule-of-thumb criteria have produced results satisfactory to those using them. Very often overprotection has resulted, but this provided no appreciable economic burden. These criteria have also been known to fail, sometimes with a resulting large economic loss.

The necessity for the use of basically sound criteria is graphically demonstrated by the results of the investigations discussed. Although the use of other criteria shown would have resulted in the protection of the structure from corrosion, an elaborate and costly installation would have been required.

TABLE 2 — COST BREAKDOWN — PROTECTED AND UNPROTECTED TANK BOTTOMS

Cost Analysis—Tank "B"

Tank cost, total		$134,000
Design and installation of cathodic protection		2,200
Protective coating (coal tar)		3,000
Yearly operation of cathodic protection		200
Bottom replacement		$30,500
Shutdown expense	$ 6,500	
Plate replacement	24,000	
Loss of product	(?)	

Table 2 shows the value of cathodic protection in a corrosive environment. Where interference effects may be neglected and power costs are of minor consideration, a high-quality protective coating is not required. The total cost of protection could thereby be reduced by nearly 50 per cent with only slight increase in operational cost. These cost figures are presented without analysis. Local conditions and intangibles are often governing factors. Interpretation of these data is therefore left to the reader.

TABLE 1—CATHODIC PROTECTION CURRENT REQUIREMENTS IN AMPERES

Tank	Protective coating—	Electrode location— "Remote"	Outer	Middle	Inner
A	Wax	14.5	20.5	20.2	17.0
B	Plasticized coal-tar enamel	12.2	8.0	5.5	8.0

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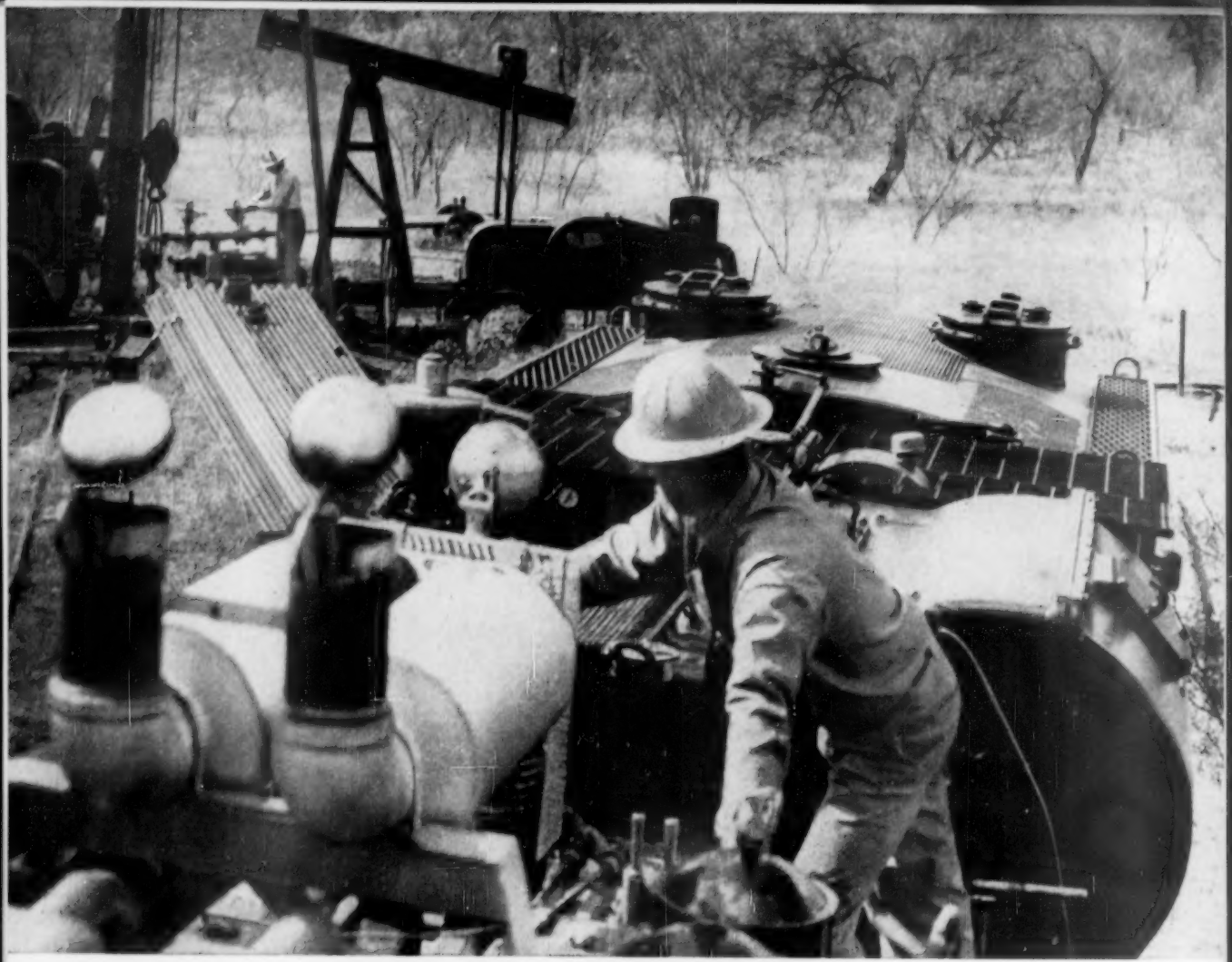

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Do You Need Proof That

Good Cutoff Practice Saves Drilling Lines?

Maybe these figures will make a believer out of you

by Ed McGhee
District Editor

HERE is the record of rotary-drilling lines at work in West Texas. Under almost identical conditions in one field, three rotary-drilling lines were put in service and careful records kept on the ton-miles each gave before being retired. What did the records show? They showed that the line with the poorest cutoff practice gave only half the service given by the line with the best cutoff practice.

Since then, the contractor owning the rigs has enforced good cutoff for drilling lines on all his rigs. Needless to say, he's saving money.

The first line . . . Table 1 gives the record of the first line into service. Notice that there is no regularity among the ton-miles put on the line before a cut was made. The ton-miles between cuts vary from as little as 659 to as many as 3,045. The manufacturer of the line had recommended that 50 ft. be cut every 1,000 ton-miles.

Now look at the cutoff lengths. No regularity here either. On the second cut, 120 ft. had to be taken off. Then, when the fourth cut was made, 450 ft. of the line had to go. Farther on, 300 ft. and then 800 ft. were sacrificed.

By the time this line was retired, it had only 35,312 ton-miles on it. This means that the 5,000-ft. reel had given only 7.06 ton-miles for each foot of line. A very poor average—and it's not the fault of the line. It was a good quality line that failed early because it was abused. The 17 cuts made during its life averaged 170 ft. each—too many ton-miles between cuts caused irregular wear.

The second line . . . Service given by the next drilling line is given in Table 2. This line was the same size, quality, and brand as the first. Although not on the same rig, drum diameter and sheave diameter for it were about the same, and it was in the same field.

At first, there is no regularity in the ton-miles between cuts. This lack of good practice is reflected in the necessity of making extremely long cuts at times—500 ft. at one cut, 375 ft. at another, and 450 ft. at still another cut. Then, the drillers began at depth of 11,823 ft. to follow closely the recommendation of the line's manufacturer to make a cut every 1,000 ton-miles. Notice from this point on there is no exceptionally long cut. Twenty-nine cuts averaging 104 ft. each were made during the life of the line.

When Line 2 was finally retired, it had made 41,219 ton-miles—or an average of 8.25 ton-miles per foot of the 5,000-ft. reel. This service is a definite improvement over that of Line

"Each rig must have its cutoff program tailered especially for it and for the type of drilling it is doing. Some of the things that affect the program will be well depth, formations being drilled, height of the mast or derrick, the diameters of the draw-works drum and sheaves, and number of lines strung."

1, but it is still not nearly as much service as is built into the lines.

And the third . . . Table 3 gives the record on the third line which was used on the same rig and under the same condition as Line 2. Although some cuts were made far from the recommended 1,000-ton-mile mark, the line received good treatment. That good treatment paid off in longer life for Line 3.

Instead of the 17 cuts on Line 1 and the 29 cuts on Line 2, Line 3 was cut 49 times—but the average cut was only 58 ft. As a result, Line 3 had 63,127 ton-miles on it at retirement, or 12.63 ton-miles per foot of the 5,000-ft. reel.

This line with good cutoff practice gave almost twice as much service as the first line and about 1½ times the service as the second.

Setting Up a Cutoff Program

Each rig must have its cutoff program tailored especially for it and for the type of drilling it is doing. Some of the things that affect the program will be well depth, formations being drilled, height of the mast or derrick, the diameters of the draw-works drum and sheaves, and number of lines strung.

Well depth is important because it determines the way in which service is put on the drilling line. For instance, in shallow wells less of the wear on the line is put on during round trips; while in deep wells, round trips account for most of the line's service. In fast drilling, where the hole must be reamed on every joint, ton-mile figures don't represent as accurately the line's wear as they do in harder, slower drilling.

On deeper wells, more parts of line are usually strung. This is harder on the line. For example, in picking up a 90-ft. stand of drill pipe with eight lines, 720 ft. of rope travels over the fast sheave and onto the drum. But if 10 lines are strung, 900 ft. of rope is put over the fast-line sheave and onto the drum in order to pick up the same 90-ft. stand.

During fishing jobs or when pulling on stuck pipe, the operator should be especially careful not to let the ton-miles build up beyond the recommended amount.

Strangely enough, the area where the

TABLE 1—ROTARY-DRILLING-LINE SERVICE RECORD

Reel 92,353; 5,000 ft. 1¼-in. line used in Pegasus field, south of Odessa, Tex.

Draw works:
National 125.
Drum diameter, 28 in.
Drum length, 42 in.
Grooved bar installed on drum.

Number of lines strung—8 all the way.

Total ton-miles = 35,312 (not including T.M. drilling).

Round trips between cuts	Depth (ft.)	Ton-miles between cuts	Cutoff lengths (ft.)
5	11,978-12,022	1,523	60
7	12,066-12,395	2,203	120
3	12,428-12,547	978	90
2	12,568-12,590	659	450
3	12,608-12,676	996	90
9	12,676-12,822	3,045	120
9	12,868-13,085	2,457	120
3	13,085-13,141		
12	242- 3,801	1,052	300
9	3,812- 5,030	833	60
23	5,126- 7,279	3,250	90
14	7,291- 8,043	2,586	90
11	8,095- 8,810	2,359	120
12	8,937- 9,557	2,746	90
9	9,587- 9,960	2,126	90
7	10,045-10,352	1,752	800
12	10,380-10,559	3,135	70
7	10,569-10,840	1,888	120
6	10,939-11,309	1,724	(*)
163		35,312	2,880

*Line retired.

Analysis of Rotary-Drilling-Line Service Record

Reel 92,353; 5,000 ft. 1¼-in. line used in Pegasus field, near Odessa, Tex.

Total ton-miles service	35,312
Ton-miles per foot line	7.06
Total number of cuts made	17
Total amount of rope reported cut off, ft.	2,880

$$\text{Average ton-miles between cuts} = \frac{\text{Total ton-miles service}}{\text{Total number of cuts made}} = \frac{35{,}312 \text{ ton-miles}}{17 \text{ cuts}} = 2{,}080$$

$$\text{Average length of cut} = \frac{\text{Total length cut off}}{\text{Total number of cuts}} = \frac{2{,}880 \text{ ft.}}{17 \text{ cuts}} = 170 \text{ ft.}$$

TABLE 2—ROTARY-DRILLING-LINE SERVICE RECORD

Reel 26,835; 5,000 ft. 1¼-in. line used in Pegasus field, south of Odessa, Tex.

Draw works:
Unit 30.
Drum diameter, 31 in.
Drum length, 42½ in.
LeBus groove bar installed.

Number of lines strung—8 all the way.

Total ton-miles service = 41,219. Ton-miles per foot line = 8.25.

Round trips between cuts	Depth (ft.)	Ton-miles between cuts	Cutoff lengths (ft.)
4	12,945-12,998	1,350	50
3	13,068-13,130		
14	0- 4,165	2,066	125
9	4,310- 5,451	1,126	50
6	5,562- 6,650	906	50
6	6,730- 7,468	1,071	†50
5	7,670- 8,201	2,213	90
5	8,327- 8,740	1,206	90
3	8,850- 9,090	*779	500
3	9,217- 9,390	712	90
10	9,490-10,006	2,569	90
4	10,006-10,285	1,097	†30
1	10,342	1,383	375
4	10,388-10,525	1,127	90
5	10,573-10,688	1,127	†30
4	10,722-10,819	1,175	†30
1	10,851	2,913	†30
8	10,881-11,093	2,419	180
6	11,124-11,340	1,880	90
6	11,405-11,627	1,962	60
4	11,643-11,692	1,216	90
4	11,698-11,705	1,342	60
2	11,730	661	450
5	11,741-11,800	1,454	60
3	11,823-11,873	1,020	50
3	11,902-11,955	975	30
2	11,974-11,984	647	60
4	11,989-11,993	1,294	30
3	11,997-12,007	969	60
3	12,016-12,034	975	30
2	12,043-12,053	653	30
3	12,065-12,135	988	30
3	12,156-12,165	990	30
3	12,172-12,179	993	30
3	12,187-12,206	996	30
4	12,223-12,246	1,335	(‡)
158		41,219	3,000

*Spooling trouble. †Slip. ‡Line retired.

Analysis of Rotary-Drilling-Line Service Record

Reel 26,835; 5,000 ft. 1¼-in. line used in Pegasus field, south of Odessa, Tex.

Total ton-miles service	41,219
Ton-miles per foot line	8.25
Total number of cuts made	29
Total amount of rope reported cut off, ft.	3,000

$$\text{Average ton-miles between cuts} = \frac{\text{Total ton-miles service}}{\text{Total number of cuts made}} = \frac{41{,}219 \text{ ton-miles}}{29 \text{ cuts}} = 1{,}420$$

$$\text{Average length of cut} = \frac{\text{Total length cut off}}{\text{Total number of cuts}} = \frac{3{,}000 \text{ ft.}}{29 \text{ cuts}} = 104 \text{ ft.}$$

rig is drilling makes a difference. Cutoff programs are different in the West Texas-New Mexico area from those in the Gulf Coast, Mid-Continent, and elsewhere.

Smaller diameters on draw-works drum and on sheaves means less service for drilling lines. This is because sharper bending around smaller diameters puts greater stresses on the line. Likewise, smooth drums give poorer line service than do grooved drums.

Where is wear? . . . Generally, there are two areas where wear is greatest. One of these extra-stress points occurs at either side of every sheave in the blocks when the elevators pick up the pipe, either going into or coming out of the hole. By far the greatest of these stress points is at the dead-line sheave, and this is one of the main reasons for following a good cutoff practice right from the beginning. If too many ton-miles are accumulated before the first cut is made, the section of rope at the dead-line sheave will be damaged. Then, after a few cuts are made, this section of line, already damaged at the dead-line sheave, has been moved over to the second or third adjacent sheave. Almost invariably a long cut will have to be made to get this damaged rope out of the blocks.

The other area is the crossover point on the drum where one layer of line laps over another. Therefore, the slipping-cutting procedure must be such that no portion of line that has been at one of the stress points will be moved directly to another. It is this fact that makes the dimensions of the derrick, drum, and sheaves important.

Measure the distance from the top of the crown sheaves to the bottom of the traveling sheaves when making a connection coming out of hole—or, in other words, when the elevators are down. Then, measure the distance from the top of the crown sheaves to the bottom of the traveling sheaves when going in the hole—or when the elevators are up. The amount of rope that is cut off at the drum should not be a multiple of either of these distances. Neither should the length of cut made at the drum be a multiple of the drum circumference. If you observe these precautions, the points of wear in the blocks at the pickup point will be changed. Also, the crossover point at the drums will be changed.

Step by step . . . To set up a good cutoff practice, here is a good procedure to follow:

First, buy the proper type and grade wire rope and buy it long enough to allow for cutting at the drum. Generally, the longest line will give the most ton-miles per foot of line. Enlist the help of the line manufacturer's representative to determine how local conditions will affect line life.

Keep daily ton-mile service records at the rig. Only the rig personnel can keep track of them.

Set up a uniform number of ton-miles between cuts. The manufacturer of the line will be glad to help in this.

Then, stick to the uniform number as closely as possible.

"Strangely enough, the area where the rig is drilling makes a difference. Cutoff programs are different in the West Texas-New Mexico area from those in the Gulf Coast, Mid-Continent, and elsewhere."

TABLE 3—ROTARY-DRILLING-LINE SERVICE RECORD

Reel 92,397; 5,000 ft. 1¼-in. line used in Pegasus field, south of Odessa, Tex.

Draw works:
Unit 30.
LeBus groove bar installed.

Number of lines strung—8 all the way.

Total ton-miles = 63,127 (not including T.M. drilling).
Ton-miles per foot line = 12.63.

Round trips between cuts	Depth (ft.)	Ton-miles between cuts	Cutoff lengths (ft.)
6	12,312-12,423	2,033	30
4	12,440-12,530	1,370	60
3	12,568-12,633	1,044	60
3	12,670-12,790	1,061	60
4	12,820-12,887	1,444	90
12	12,917-13,132		
18	0- 5,174	4,155	190
5	5,270- 5,045	583	60
5	6,152- 6,886	719	60
5	7,010- 7,783	858	60
5	7,935- 8,167	973	60
3	8,184- 8,289	547	60
10	8,324- 8,948	2,009	60
8	9,065- 9,195	1,853	60
6	9,195- 9,402	1,349	30
4	9,461- 9,635	949	50
5	9,715- 9,920	1,237	30
6	9,965-10,213	1,547	50
4	10,257-10,326	1,058	40
5	10,328-10,444	1,340	60
5	10,480-10,570	1,369	90
6	10,578-10,862	1,689	60
5	10,896-11,120	1,471	50
5	11,169-11,315	1,523	90
4	11,348-11,407	1,241	200
3	11,407-11,417	933	65
3	0-11,417	933	50
4	11,417-11,446	1,245	30
3	11,458-11,493	939	30
3	11,539-11,605	951	50
3	11,629-11,680	960	30
4	11,713-11,779	1,296	60
3	11,791-11,810	978	30
4	11,820-11,848	1,310	100
3	11,857-11,870	970	60
3	11,873-11,886	972	30
3	11,893-11,905	975	60
3	11,913-11,982	981	60
3	11,988-12,009	987	30
3	12,017-12,050	991	70
3	12,072-12,101	997	65
3	12,132-12,250	1,010	30
3	12,272-12,298	1,024	60
3	12,317-12,378	1,032	30
3	12,419-12,470	1,044	60
3	12,510-12,588	1,058	30
3	12,606-12,661	1,068	30
3	12,700-12,770	1,083	30
7	12,771-12,847	1,775	30
4	12,938-13,072	1,005	60
4	13,111-13,126		
27	0- 6,146	3,188	(*)
260		63,127	2,840

*Line retired.

Analysis of Rotary-Drilling-Line Service Record

Reel 92,397; 5,000 ft. 1¼-in. line used in Pegasus field near Odessa, Tex.

Total ton-miles service	63,127
T.P.M.-miles per foot line	12.63
Total number of cuts made	49
Total amount rope reported cut off, ft.	2,840

Average ton-miles between cuts

$$\frac{\text{Total ton-miles service}}{\text{Total number of cuts made}}$$

$$\frac{63{,}127 \text{ ton-miles}}{49 \text{ cuts}} = 1{,}290$$

Average length of cut

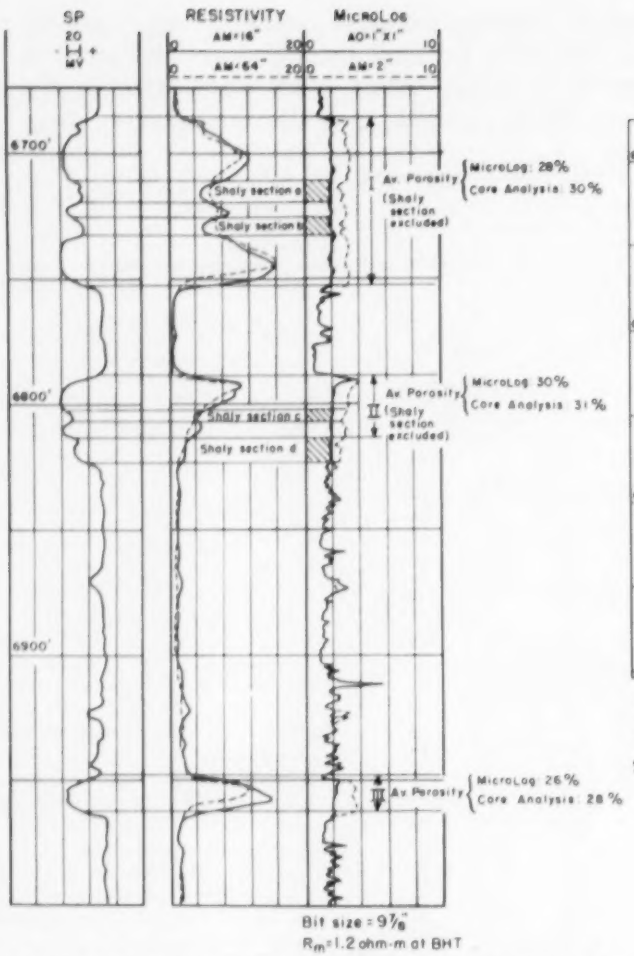
$$\frac{\text{Total length cutoff}}{\text{Total number of cuts}}$$

$$\frac{2{,}840 \text{ ft.}}{49 \text{ cuts}} = 58 \text{ ft.}$$

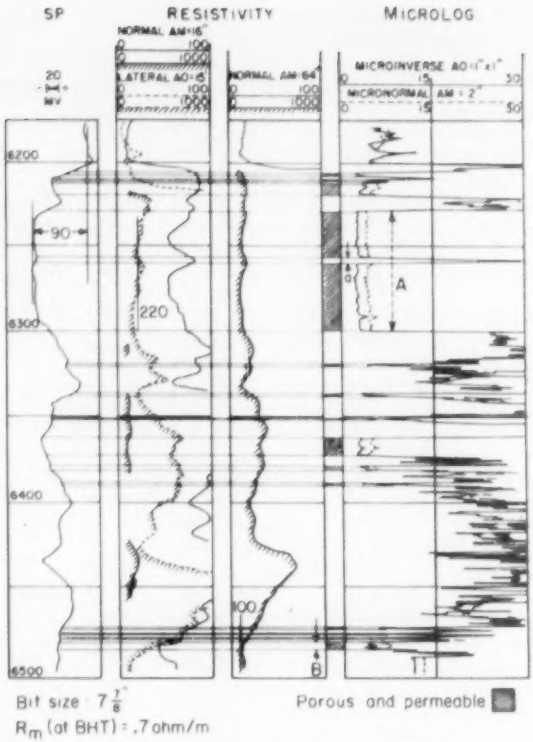
Acknowledgment

Credit is due R. D. McNutt and M. K. Petty of American Chain & Cable Co. for the information they contributed to this article.

"Come, come, Murchison—In times like these the least you could do is work yourself up into a high nervous tension."



EXAMPLE OF QUANTITATIVE INTERPRETATION of MicroLog in clean formations of high porosity (Gulf Coast). Fig. 6.



Section A	average value of $\frac{R_{xo}}{R_{mf}}$ from MicroLog	= 40
	average porosity (supposing 15% ROS)	17%
	average formation factor	30
	R_w from SP curve	0.035
	R_t from Lateral	130
	Water saturation :	10%

USE OF MICROLOG in the determination of porosity and fluid saturation. Fig. 7.

With the MicroLog . . . You Can Be Sure

The previous article explained how the MicroLog may be used to identify different types of formations. This article tells how the MicroLog is used to determine porosity, oil saturation, and the index of producible oil of permeable formations. Also tells how the MicroLog can locate oil-water or gas-water contacts.

Part 2

by Maurice Martin

QUANTITATIVE analysis of formations is a technique made possible by recent developments in electric logging. By the use of resistivity measurements of the formation and the drilling mud, porosity, saturation, and eventually Maximum Producible Oil Index may be obtained.

When formation porosity is not too low (not less than about 15 per cent), the MicroLog makes possible these determinations. One important measurement, obtainable from the MicroLog, is the flushed-zone resistivity, R_{xo}. From R_{xo} and mud filtrate resistivity, the formation factor is obtained which leads to determination of porosity and saturation.

Formation factor . . . If a formation is practically clean and entirely impregnated with an electrolyte, the ratio of the resistivity of the formation to the resistivity of the electrolyte is a constant, whatever the resistivity of this electrolyte. This constant designated as "formation-resistivity factor"—or more simply "formation factor"—in turn is a function of the lithology of the formations, mostly of the porosity. The following formula has been proposed to express the relationship between formation factor and porosity:

$$F = \frac{a}{(\phi)^m} \qquad (1)$$

with F being the formation factor, ϕ the porosity, and a and m two parame-

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ters, depending on the nature of the formations.

Several values, variable mostly with the types of formations selected for the experiments, have been proposed for a and m, but the curves showing F vs. ϕ for these various values of a and m are not much different from one another.*[7,8,9]

To determine porosity . . . The evaluation of porosity through electrical measurements is based on the determination of the formation factor. For such a determination to be possible by measurements in situ, it should be assumed that there exists one part of the porous formation under study which is saturated with a water of known resistivity, and that the resistivity of this part of the formation can be measured.

Within a short distance from the wall of the hole, the connate water is entirely displaced by the penetration of mud filtrate. The oil remaining in the pores, if any, is reduced to a small amount. The value generally accepted for the extension of this flushed zone from the wall is about 2 to 3 in.† Further on, the proportion of original fluids progressively increases until a distance is reached where the formation is completely uncontaminated.

Accordingly, when there is no residual oil in the flushed zone, as in the case of water-bearing formations, the formation factor—still supposing the formation is practically clean—will be equal to R_{xo}/R_{mf}, with R_{xo} being the resistivity of the flushed zone, and R_{mf} the resistivity of the mud filtrate. The porosity given by the formula of W. A. Winsauer et al. will be:

$$\phi = [0.62\ (R_{mf}/R_{xo})]^{1/2.15} \qquad (2)$$

In the case of oil-bearing formations, if ROS is the residual oil saturation, the formula will become:

$$\phi = \frac{1}{1 - \text{ROS}}\,[0.62\ (R_{mf}/R_{xo})]^{1/2.15} \qquad (3)$$

Residual oil saturation . . . Factor ROS is not exactly known. Its value has to be surmised from the information furnished by core analysis. It is generally accepted that taking a value for the residual oil saturation of 20 per cent would usually result in reasonably small errors in most cases, at least in formations with granular porosity. However, greater residual oil saturations may occur frequently, chiefly in the cases of low-gravity oil and tight formations where the flushing by the mud is more difficult. Gas-bearing formations also seem to display high residual saturations in the flushed zone.

The value of R_{mf} can be measured directly on samples of filtrate pressed out of the mud by means of an appropriate filter press. If this cannot be done, R_{mf} can be estimated from the value of R_m, the mud resistivity, according to average statistical data obtained in the laboratory. The evaluation of the formation factor, and hence of porosity, finally depends on the determination of R_{xo}.

Flushed zone resistivity . . . The value of R_{xo} can be derived from the MicroLog. Except in the case of very shallow invasion, the radius of investigation of the MicroLog does not extend beyond the flushed zone. The measured resistivities are therefore functions of the resistivity of the flushed zone (R_{xo}), of the hole diameter (d), of the resistivity of the mud cake (R_{mc}), and of the thickness of the mud cake (t_{mc}).

Interpretation charts have been established, on the basis of laboratory determinations, which make possible the derivation of the value of R_{xo} and t_{mc} from the two MicroLog readings, provided the values of d and of R_{mc} are known. The hole diameter is generally known from the bit size, or better from a section gage or a Microcaliper log. The value of R_{mc} can be obtained, as for R_{mf}, by direct measurements on mud cakes pressed from actual samples of the mud, or from average statistical data.

Three series of such charts have already been published. The first, Series A, was a preliminary one which was soon superseded by Series B, included in Schlumberger Document No. 5. Series B corresponds to a type of pad (called WRS-D) which has now been replaced almost everywhere by a new improved type (hydraulic pad). A Series C chart for use with the hydraulic pad is now being published. Interpretation documents equivalent to Series C charts are also available in the form of nomograms.

Accuracy of porosity calculation . . . When R_{xo} is not too great in comparison with R_{mc} (as is the case in high-porosity formations), the MicroLog readings are not too much affected by the presence of the mud cake, and R_{xo} can be obtained with a fair accuracy.

This is not true when R_{xo} is very great in comparison with R_{mc}; i.e., in the case of low porosity. (This effect of the value of R_{xo}/R_{mc} is shown clearly by the interpretation charts: for high values of R_{xo}/R_{mc}, the curves for constant values of R_{xo}/R_{mc} are very crowded, so that a small error in the determinations of $R_{2''}$ and $R_{1''\text{-}x1''}$ corresponds to a much larger error in the value of R_{xo}.)

So there is a lower limit of porosity values below which the quantitative interpretation of the MicroLog is not too reliable. With the hydraulic type of pad, the limit is about 15 per cent.*

Water and oil saturation . . . Again supposing the formation is practically clean, water saturation in the uncontaminated zone of a reservoir bed can be expressed by Archie's formula.

$$S_w = [(F \times R_w)/R_t]^{1/2} \qquad (4)$$

where:

S_w = water saturation
R_w = resistivity of connate water
R_t = true resistivity of formation

The application of the same formula in the flushed zone gives:

$$S_{xo} = [(F \times R_{mf})/R_{xo}]^{1/2} \qquad (5)$$

where S_{xo} is the water saturation (equals 1 — ROS).

Combining Equations 4 and 5 gives:

$$S_w = S_{xo}\,[(R_{xo}/R_{mf}) \times (R_w/R_t)]^{1/2} \qquad (6)$$

The evaluation of saturation, accordingly, requires the determination of R_{xo}.

On the other hand, the value of R_t is not always given without correction by the resistivity logs because of the influence on the measurements of the mud column, of bed thickness, and of invasion. Even with the induction log, which is appreciably more accurate in this respect than the conventional log, it may be necessary to account for the invaded zone when the depth of invasion is great. The knowledge of R_{xo} is fundamental in the application of the departure curves which provide for the necessary correction.

The MicroLog is therefore valuable for the determination of saturation in those formations where it can give R_{xo} with enough accuracy—i.e., when the porosity is great enough.

Producible oil . . . The value of R_{xo} is also necessary for the evaluation of the so-called maximum producible oil index which can be defined briefly as follows:

The quantities $S_{xo}\,\phi$ and $S_w\,\phi$ represent the amounts of water per bulk volume present in the pores of the flushed zone and of the uncontaminated zone respectively. The difference $Y = (S_{xo} - S_w)\,\phi$ therefore is the amount of oil per bulk volume which has been displaced by the penetration of mud filtrate. This factor is called the maximum producible oil index because it

*The equation proposed by W. A. Winsauer et al., namely $F = 0.62/(\phi)^{2.15}$, has been used for the computation of the numerical values of porosity given in the interpretation charts.

†Except in case of very low-water-loss mud and/or high-permeability sands, where the invasion may be very shallow.

*Another device, the Microlaterolog, is available for the determination of R_{xo} whatever the porosity of the formation, provided the mud cake is thin and high salinity muds are used.

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can be taken as representing approximately the total amount of oil per bulk volume which can be produced from the formation in conditions of complete recovery by water drive.

It can be shown that Y is given by the approximate equation:

$$Y = (R_{mf}/R_{xo})^{1/2} - (R_w/R_t)^{1/2} \quad (7)$$

Charts are available for a convenient computation of Y.[11]

The determination of Y is useful in estimating reservoir productivity because Y takes into account the possible movement of the oil. The knowledge of saturation and porosity does not always make possible a safe estimation, even only qualitatively, of the rate of production to be expected from a reservoir. When, for example, the reservoir contains very viscous oil, a good oil saturation may correspond to a very low rate of production and even to no production at all.

The determination of the maximum producible oil index provides useful additional information in this respect: if it be found that a certain amount of oil was displaced outwardly by the action of mud filtrate during the drilling process, it is likely that oil can flow in the reverse direction towards the bore hole when the well is tested for production. If, conversely, no oil was displaced by the penetration of mud filtrate, no significant production should be expected, however great the oil saturation may be.*

Another interesting point in using the maximum producible oil index is that its value does not depend on the residual oil saturation. This eliminates a source of uncertainty in log analysis.

Field Examples

. . . **(a) Fig. 6** shows the conventional curve and the MicroLog recorded through the Yegua formations in a Gulf Coast well.

The data for this well are: bit size, 9⅞-in.; R_m, 1.2 ohm-m at b.h.t. (150° F.)

The values of porosity computed from the logs for the three sand intervals, 1, 2, and 3, and averaged up over these intervals are shown on the figure, matched with the average values derived from core analysis.

In this study, the intervals, a, b, c, and d, have been excluded since they contain a substantial amount of shale according to the MicroLog, the S.P. curve, and the conventional resistivity curves.

. . . **(b) Fig. 7** shows the MicroLog and the conventional curves recorded in a North Texas well. Several porous and permeable sections are indicated by the MicroLog (crosshatched areas on the figure). Among them, Section A will be considered below.

If the thin tight streak denoted as a be discarded, the quantitative analysis of the MicroLog in Section A shows that the formation factor and the porosity vary within comparatively narrow limits throughout the section. In other words, the whole section can be taken as being one single, fairly homogeneous bed. The total thickness of this bed is about 70 ft. so that the effect of the adjacent formations on the values recorded on the conventional curves, even on the long lateral curve, can be neglected.

. . . **The average value** of R_{xo}/R_{mf} throughout the section, as derived from the MicroLog charts, is equal to 40. Supposing 15 per cent residual oil in the flushed zone, the corresponding value of the average porosity would be about 17 per cent.

. . . **The amplitude** of the deflection of the S.P. curve is equal to —90 mv. Taking the K coefficient, in the equation of the electrochemical S.P., equal to 80 at b.h.t., the corresponding R_{mf}/R_w is about 14. A value of $R_m = 0.7$ at b.h.t. corresponds to a value of 0.5 for R_{mf}. R_w is found to be 0.035, as a first approximation.

. . . **The average** apparent resistivity read on the long lateral throughout the section is equal to 220 ohm-m. This, after correction with the departure curves, gives an average value of 130 ohm-m for R_t. Hence, a value of about 10 per cent is found for the water saturation.

The computations of water saturation in the other permeable and porous sections is not so easy because these sections are comparatively thin. Also, their true resistivities cannot be determined accurately from the conventional logs. Considering, for example, Section B, whose thickness is about 4 ft. according to the MicroLog, it appears that the long lateral curve is very much distorted and cannot be relied upon. Because of the presence of the tight formations above and below the bed, it is likely that the value read on the long normal, namely 100 ohm-m, is an upper limit for R_t. A reasonable lower limit can be taken equal to 50 ohm-m. Furthermore, the S.P. curve is not entirely developed, but it can be assumed that the value of R_w is the same as in Section A, i.e., 0.035 ohm-m.

The MicroLog gives, for the formation factor, a value about equal to 35, hence the water saturation would be between $(35 \times 0.035/100)^{1/2}$, or 11 per cent, and $(35 \times 0.035/50)^{1/2}$, or 15 per cent. This result, of course, is a very rough approximation because of the uncertainty in the values of the factor involved, particularly of R_t. The value of R_t, and accordingly of saturation, would be obtained with a much greater accuracy using the induction log.

Almost all the permeable sections were gun perforated; the well produced 214 bbl. of oil per day through a 16/64-in. choke.

Case of shaly sands . . . The presence of shales or clays within a sand body is a source of difficulty in electrical-log interpretation.

Shales or clays, whether deposited in thin laminations or dispersed in the interstices of the sand, contribute to the electrical conductivity of the formation without contributing to its effective porosity. The basic equations of quantitative analysis given in the foregoing do not apply, therefore, when the sand contains an appreciable amount of shaly material. In particular, if $(\phi)_e$ is the effective porosity of the formation, the value of R_{xo} is lower than it would be in a clean formation with the same porosity $(\phi)_e$. Accordingly, the porosity value derived with the interpretation charts from the MicroLog readings opposite a shaly sand is greater than the effective porosity of the formation.

On the other hand, the presence of shale in a sand decreases the deflection of the S.P. curve with respect to the amplitude which would be observed for a clean sand, all other conditions (thickness, salinity of connate water, etc.) being the same.

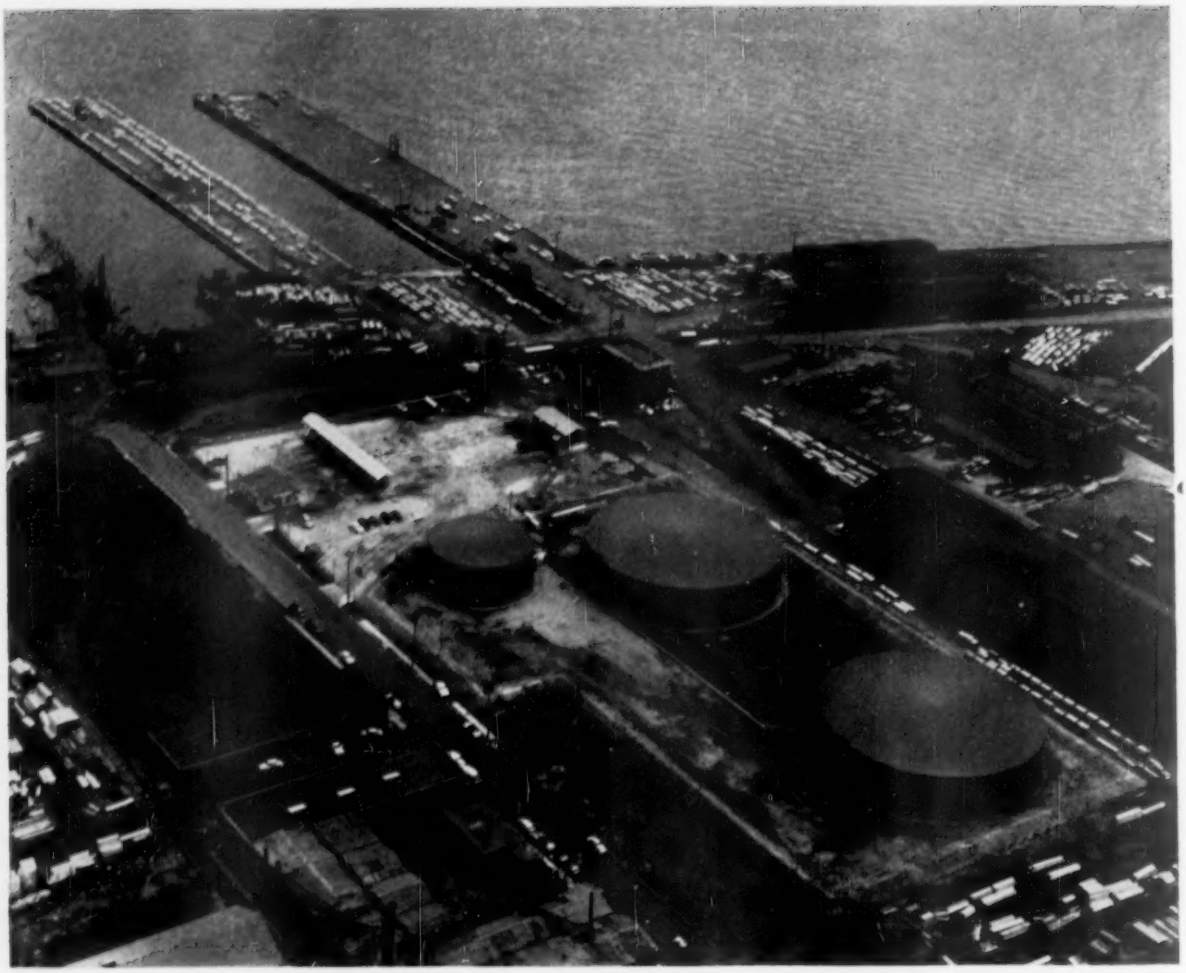
The problem of electric-log interpretation in shaly sands is complex. It has already been the subject of numerous investigations both in the field and in the laboratory.[12 13 14 15] An approximate method has been proposed which is directly applicable to practical log interpretation and which has already received the confirmation of a great deal of field experience. A discussion of this method would go beyond the scope of the present paper, and reference is made to the corresponding publication.[13]

It will be stated only that the interpretation according to the method makes use of two comparatively simple charts for the estimation of saturation and porosity respectively (a chart for the computation of the maximum producible oil index can be found also in Reference 11).

For the publication of these charts, the knowledge of R_{xo} is necessary. The value of R_{xo}, of course, is derived from the MicroLog exactly as in the case of clean sands.

References cited above were given in the first part of this article.

*This supposes that no process (such as acidizing, artificial fracturing, shooting, etc.) which changes the physical conditions in the formations has intervened between the moment the logs are run and the moment the formation is tested.



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Other facilities on the five-acre tract include tanker and barge berths, an up-to-the-minute truck loading rack and an attractive office building. Architect for the project was Sidney Jelinek; engineer and constructor was Leonard Shaffer Co.

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by W. L. Nelson
Technical Editor

QUESTIONS ON TECHNOLOGY

Technical Filing System

Can you suggest a system of filing for the mass of information that comes to us? Most of the systems shown in the literature do not seem to meet the practical subjects that we encounter.—D.A.P.

A filing system is so intimately related to the particular needs of an individual or department or committee that it must be the outgrowth of these needs. No one can offer anything but general advice. Published filing systems seldom suggest file headings needed by practical plant men.

Two general types of files are available, alphabetical files of pertinent subjects and numbering systems which provide, at least theoretically, a number for any possible subject. The primary advantage of the alphabetical index is the ease with which the various file titles can be brought to mind; both filing and searching can be done by memory especially if the file has been developed by those who use the file. However, there are practical limits to the size of an alphabetical file and to the memory of the users. Such a file can be very confusing to a new user because he must resort to the alphabetical index of the file folders to discover the pattern of the file. Thus, if the file is to be used by a large number of more or less laymen who must always resort to the index of the file, the more elaborate numbering system type of file may be justified. These suffer from the same troubles as the alphabetical index but at least they can be all comprehensive as to subject matter.

The building of an alphabetical file can scarcely be discussed because each situation requires its own subject matter but just as an illustration, a file might start as follows:

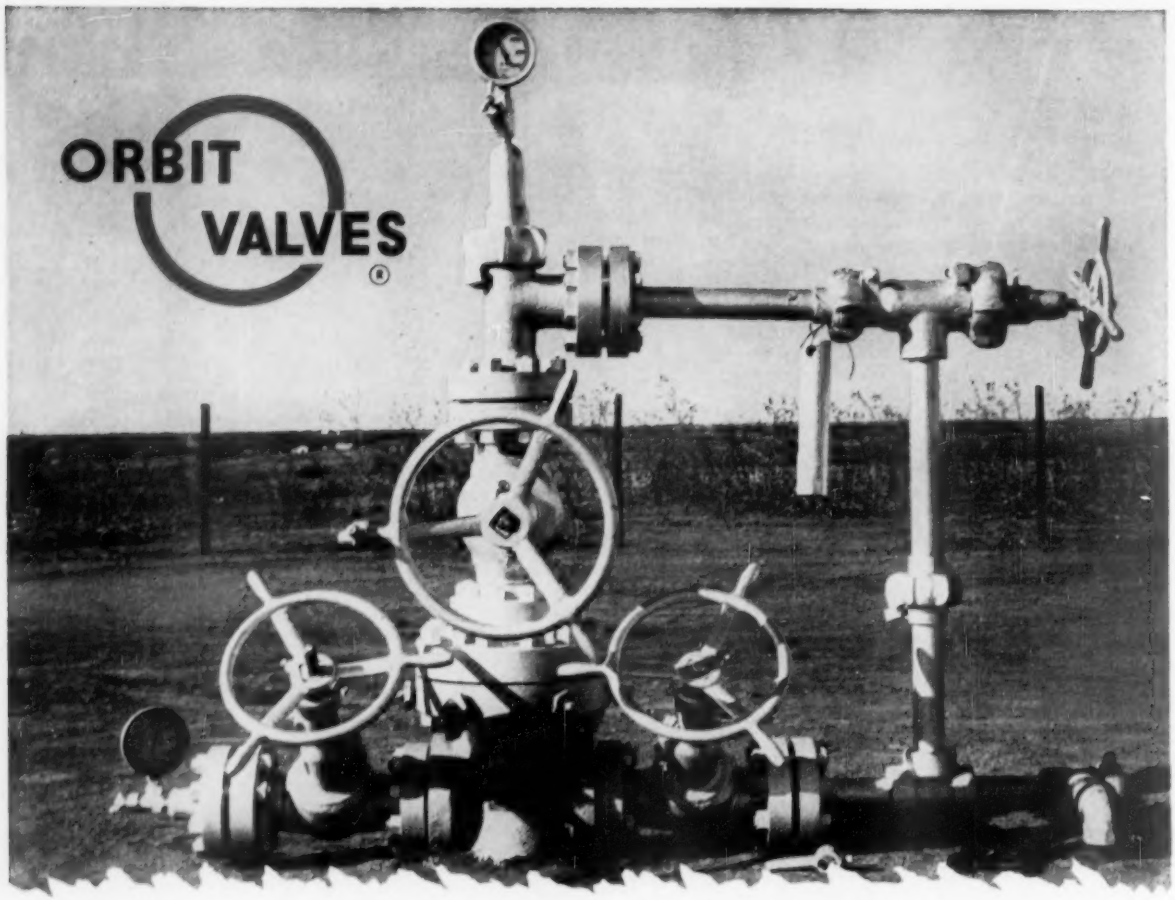
Absorption (and stripping), theory
Acidizing
Additives
Adsorption, theory
Alcohols (from petroleum)
Alkylation, theory
Alkylation, processes
Analysis, general physical
Analysis, chemical
Analysis, routine tests
Analysis, spectroscopic
Aromatization, theory
Aromatization, processes
Asphalt (and road oil)
Atomic energy
Atomic oil applications

Evidence of the need of memorizing or knowing the file arrangement is already evident as noted "alcohols (from petroleum)" and "asphalt (and road oil)." The user or filer must know that information on alcohol production from petroleum is not filed under "petrochemicals" or under "chemical processes" and that information on the use of alcohols as motor fuels is not to be filed in the "alcohol" folder. Likewise, he must know that information on road oil is grouped with "asphalt."

The numbering system published by W. L. Bolles (Pet. Refiner, May 1949, page 140) illustrates this type of filing system. He suggests over 130 secondary file headings (not detail material) pertaining to chemical engineering and under the general heading of Chemical Technology (500) we find No. 564 which pertains to petroleum. His file numbers for petroleum are shown in Table I except that subjects of more interest to plant men, as requested in the question, have been added to his system. Thus, numbers past 564.700 pertaining to Economics, Equipment, and Maintenance and Inspection have been added. Lack of additional numbers requires that information on Operation be filed under Refining (564.55), and information on evaluation of raw stocks (crude oil and feed stocks) under Raw Material (564.47).

TABLE I—NUMBER INDEX OF PETROLEUM INDUSTRY

564	Petroleum industry
.0	Petroleum technology in general
.01	Definitions; Philosophy; Outline
.02	Statistics; Facts
.03	Societies and organizations
.04	Journals
.05	Bibliographies; Abstracts
.05	Patents
.07	Companies; Plants; Refineries
.08	Research; Organizations
.1	Fundamentals; Chemistry of petroleum materials
.2	Physical and chemical data
.21	Petroleum products
.22	Physical data
.23	Thermal and thermodynamic data
.24	Chemical data
.25	Miscellaneous data
.26	Experimental methods
.27	Experimental apparatus
.3	Analysis and testing
.31	Analysis for hydrocarbons
.32	Analysis for nonhydrocarbons
.33	Analysis and testing of petroleum products
.34	Special tests
.35	Testing equipment
.4	Raw material; Petroleum
.41	Occurrence of petroleum
.42	Composition of petroleum
.43	Prospecting
.44	Drilling
.45	Producing
.46	Transportation
.47	Evaluation of crude oil
.48	Analyses of crude oils
.5	Refining
.51	Unit processes
.52	Treating processes
.53	Separation processes
.54	Refining of petroleum products
.55	Operation
.6	Products; Utilization; Applications
.61	Engine fuels
.62	Lubricants
.63	Burner fuels
.64	Solvents
.65	Chemicals
.66	Specialties
.67	Miscellaneous products
.7	Economics
.71	Costs
.711 etc.	equip., indexes, labor, operation, transportation, plants, miscellaneous
.72	Breakeven studies
.73	Depreciation rates
.74	Finance
.75	Prices
.751 etc.	oil products, crude oil, supplies
.76	Realizations
.77	Taxation
.8	Equipment and materials
.81	Combustion
.811 etc.	furnaces, pipestills, burners, etc.
.82	Vessels
.821 etc.	tanks, towers, settlers, storage tanks, etc.
.83	Exchangers
.831 etc.	tubular exchangers, fin tubes, tubular coolers, coil coolers, condensers, etc.
.84	Fluid handling
.841 etc.	pipe, fittings, valves, compressors, pumps, ejectors, etc.
.85	Instruments and controls
.851 etc.	each type of service
.86	Materials
.861 etc.	insulation, refractories, metals, alloys, electrical, etc.
.9	Maintenance and inspection
.901 etc.	turnarounds, forms, rigging
.91	Corrosion
.911 etc.	neutralizing chemicals, inhibitors, retirement thickness, etc.
.92	Equipment
.921 etc.	electrical, exchangers, compressors, piping, towers, vessels, pumps, etc.
.93	Safety
.931 etc.	accident control, sabotage, fire, medical, pamphlets, etc.
.94	Laboratory
.941 etc.	sampling, sample storage, etc.
.95	Lubrication



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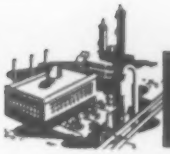

JOB IMPROVEMENT FOR THE PROCESS FOREMAN—27

Check Lists For Operating Centrifugal Pumps

Q. What's the best way to go about starting a centrifugal pump?

A. Here's a handy check list:

1. Check all flanges, bleeders, and connecting piping. Be sure all blinds have been removed.

2. Check, by turning at least one revolution by hand, the internal moving parts of both the motor and pump. Be sure direction of impeller is correct.

3. Check all grease or oil bearings and be sure enough lubrication is present.

4. Check all oil seal or water connections and be sure they are lined up and in operation.

5. With the discharge valve closed, open the suction slightly and allow the material to be pumped to fill the case. Vent the air out the bleeder located at the top of the case. If it is hot liquid, allow enough oil to bleed out to warm the case.

6. If turbine driven, the steam should be allowed to bleed through the turbine and warm it. Condensate or water is very detrimental to the turbine blades.

7. Check the exhaust valve on steam and be sure it is open.

8. With the discharge valve closed, start the motor or turbine and allow the pressure at the discharge to come up to normal. The reason for this is that the power-load requirements are lowest with the discharge closed and no work being done beyond turning the motor and the assembly in the liquid.

9. After pressure is up to normal, open the discharge valve slowly and allow the liquid to leave the pump. Any sudden opening of the discharge valve may cause the pump to lose suction.

Q. Once the pump is operating, what are some good things to keep an eye on?

A. You'll find it pays to watch these things:

1. Packing or seal system should be inspected as to any leakage or excessive heat.

2. All bearings or any oil-lubricated parts should be checked to be sure they are receiving the proper lubrication and excessive heat is not occurring.

3. The pressure at the discharge should be noticed and any sudden drop in this pressure immediately investigated. This can happen from several different causes: (a) losing suction due to vaporization or lack of liquid and suction; (b) overload on motor or turbine; and (c) freezing or sticking of some moving part in the assembly.

4. The impeller assembly is rotating on the drive shaft and can turn either way. All impellers should turn towards the discharge. In order to pump, it must turn in the direction for which it was designed. But if the motor which turns this impeller is stopped and the discharge valve is open, the liquid can back through the pump.

Under most conditions, there is a check valve at the discharge to stop this situation. Due to leakage on a check valve or if there is not a check valve in the line, the discharge should be closed immediately if the pump stops.

5. Any undue vibration or noise in the pump or motor should be checked immediately. If they cannot be eliminated, the pumps should be shut down and a mechanic notified.

Q. How about shutting down a centrifugal pump? What's a good procedure to follow?

A. Experience has proved this to be a good approach:

1. Close the discharge valve.

2. Shut the motor or turbine down.

3. Shut the suction valve.

4. Open the bleeders on the bottom of the case and drain the pump.

5. Close the exhaust steam valve and drain the turbine. In extremely cold weather, it may be necessary to allow enough steam to bleed through the turbine to keep it from freezing.

6. If pump is to be worked on, it is necessary to close off the seal oil system and water connections and drain. If not, it's O.K. to leave it in service.

7. If the pump is to be taken out and there is pressure on the suction or discharge, blinds should be installed.

LOCATING TROUBLE IN CENTRIFUGAL PUMPS

Not enough water delivered:

(a) Air leaks in suction or stuffing boxes.
(b) Speed too low.
(c) Discharge head higher than anticipated.
(d) Suction lift too high. Check with gages. Check for clogged.
(e) Impeller completely plugged up.
(f) Not enough suction head for hot water.
(g) Mechanical defects:
  (1) Wearing rings worn.
  (2) Impeller damaged.
  (3) Casing packing defective.
(h) Foot valve too small.
(i) Foot valve or suction opening not submerged deep enough.

Not enough pressure:

(a) Speed too low.
(b) Air in water.
(c) Mechanical defects.
  (1) Wearing rings worn.
  (2) Impeller damaged.
  (3) Casing packing defective.
(d) Impeller diameter too small.

When direct connected to electric motors, check up whether motor is across the line and receives full voltage. When direct connected to steam turbines, make sure that turbine receives full steam pressure.

by R. I. Martin

ENGINEERING FUNDAMENTALS

ELECTRIC LOGGING—66

Where to Use Various Logs

All 66 of these articles will soon be available in one handy manual, priced at $1.50. Address your advance order to Department R.S., The Oil and Gas Journal, Box 1260, Tulsa.

THE Schlumberger Laterolog and Halliburton Guard Electrode represent significant advances in resistivity measurement. Both record resistivities which are close to true resistivity and are not affected by bed thickness, unless this is very thin. They actually give better results when the mud resistivity is low.

But a change from one type of log to another is not made easily. The relative positions of the short and long normal-resistivity curves form a basis for log interpretation in many cases, so that some adjustment of ideas becomes necessary when new logging methods are used. In view of the superior results obtained by the Laterolog and Guard Electrode, it is urged that they be adopted whenever conditions are suitable for their use. Some initial difficulties may be experienced, but the long-term advantages will be important enough to overcome objections which may be raised.

When these two devices cannot be used because of excessively high mud resistivity, the induction log may be used to obtain a resistivity curve. Some refinements in this device are necessary and are under active review.

The contact logs performs a useful service in defining permeable zones in dense rocks. Sometimes the permeability so indicated is too small to yield commercial production, but this is an error in the right direction. Attention paid to the information afforded by the contact logs will reduce the number of tests made.

The S.P. log gives good indications of lithology, including an indication of permeability and shale partings in dense rocks. Provided that mud resistivity is not too low, these indications are quite definite and are often more significant than those given by a gamma-ray log.

In cases where mud resistivity is too low or too high for a satisfactory S.P. curve to be obtained, the gamma-ray log may be used as a substitute. It is not completely satisfactory, however, because variations in this log are not related directly to lithology or fluid content.

Author is assistant professor of petroleum engineering, Missouri School of Mines and Metallurgy, Rolla.

THE COMPLETE SERIES of these logging articles is indexed below.

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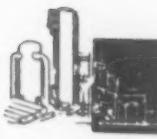
by N. E. van Fossan



FIELD PROCESSING
NATURAL GASOLINE · REFINING

UNDERGROUND STORAGE—5

Developing Salt-Bed Storage in Various Areas

THERE are many workover difficulties in the Permian basin area. Most of them are due to stringer collapse. It is surprising that stringer collapse should generally be associated with utilization of the hole in the storage portion of the cycle. This, in the writer's opinion, can be attributed to the change in floating effect—for example, between that of 1.2 specific-gravity salt water and 0.508 specific-gravity butane.

This stringer collapse naturally occurs at a most inopportune time in that the stored product may be isolated in a lower section with the tubing string pinched off and inoperative. As a consequence, the hole may be filled and the operator may not discover that a portion has been isolated until the recovery program has been accomplished.

Workover procedures are complicated by the fact that major bodies of light hydrocarbons exist in the hole under a blocking formation, which must be removed if the full storage volume of the cavity is to be utilized.

Washing procedures . . . These should take into account the possible lateral development of any one washed section. Such a section break into that of an adjoining well could result in the mixing of incompatible products or could bring about dangerous surface conditions caused by an escape of product through the return lines of the washing well.

Recoveries are generally good. Normal operating experience would indicate less than 10 per cent loss as being generally applicable. Some 100 wells have been developed in the Permian section, and possibly 40 per cent of all underground storage in the United States is concentrated in that area.

Other areas (Syracuse salt beds and the Michigan basin) will be covered next before passing on to a discussion of salt domes.

Author is with Texas Natural Gasoline Corp., Tulsa. Paper presented at N.G.A.A. Dallas meeting, 1955.

2. Syracuse Beds

The Syracuse salt beds (Fig. 3) of Silurian age lie in western New York State, extend down across the northwest third of Pennsylvania, and thence into eastern Ohio.

These beds are evaporative-type depositions of high purity, laid down in a similar manner to the salt beds of the Permian age. However, having been in the upper latitudes, major differences are noticeable. The thickness of the salt is normally low, a maximum of 200 ft. The salt is quite lensatic (that is, not necessarily a continuous body of a single stringer of salt) and is rather unpredictable in thickness, area, and extent. Some overlapping of insolubles is present.

The salt mass, in general, outcrops near Syracuse. From that point it dips to the southeast at about 45 ft. per mile to such an extent that, as the salt passes through Pennsylvanian (Fig. 3, Installment 4), it is too deep for practical utilization at this time.

As would be expected from the nature of the evaporative deposition, the capping rocks are also evaporative. Their occurrence in general is as unpredictable as that of the salt lenses. It would be expected that where good salt formations are in evidence, at that same point good capping formations will also exist.

This particular area has been used by two organizations with a total of three wells drilled. Cable-tool rigs are in general use. Casing strings are set in the capping formation, and the salt penetrated to the desired point, which depends on the lens system itself and the possibility that other lenses will exist in the same penetrated area.

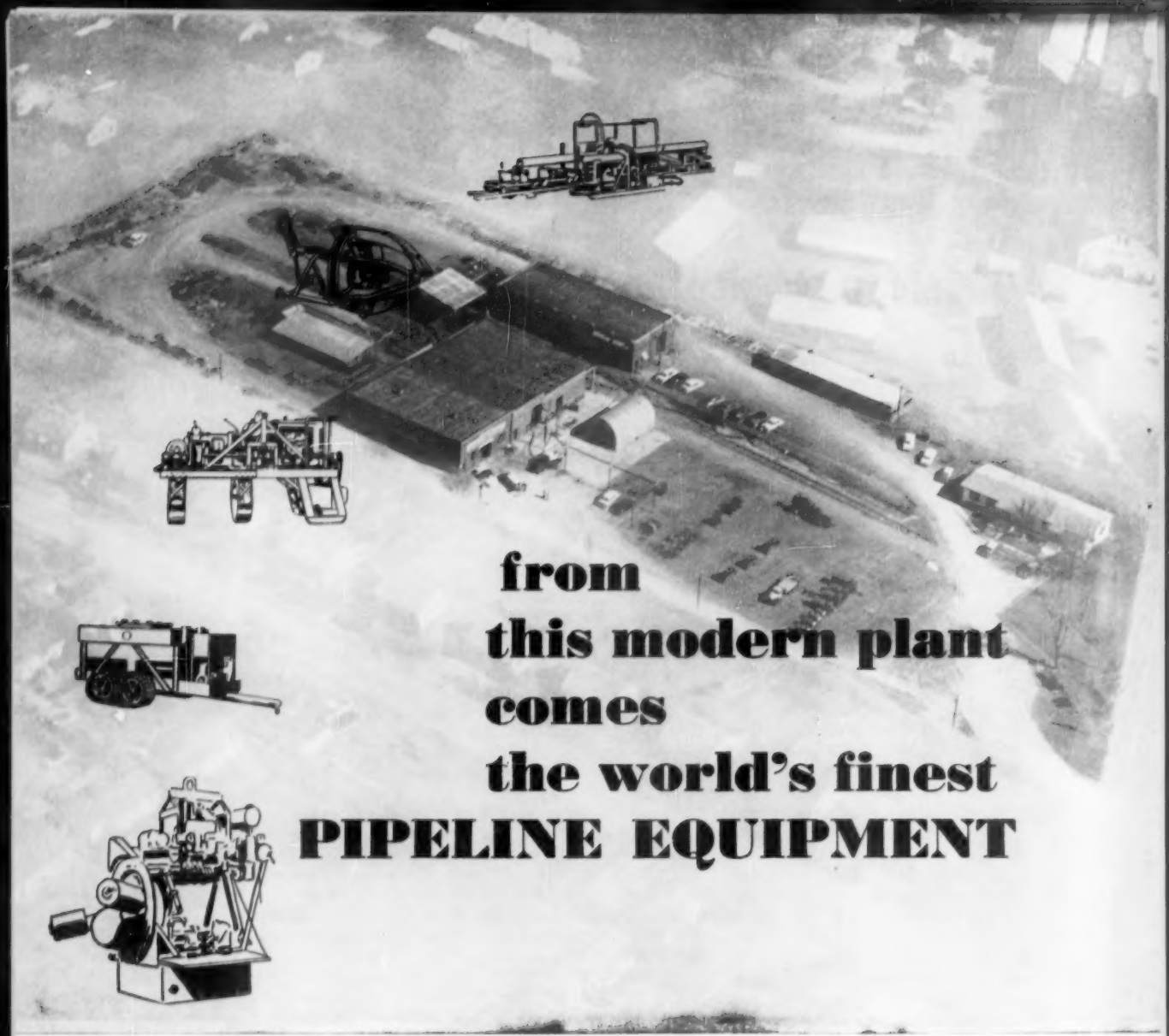
With narrow salt sections encountered and with good existing capping formation, top-washing procedures will possibly be the best. "Trump" blanket procedures were first used in this area because of the existence of a shale layer under the evaporative capping formation. Trump blankets naturally infer a floating-liner system. Probably not in excess of 125,000 bbl. of storage has thus far been developed. Little is known as to the recovery experience.

3. Michigan Basin

The Michigan basin (Salina) salt beds are of similar nature to, and at the same age of, those of the Syracuse. But they seem to be more thick and to be more concentrated in area due to the syncline that gives the Michigan basin its name. Extensions of this syncline also extend into Ontario.

Surface to top of salt range from 1,000 ft. at the outer edge and, going inward, dips down to 5,000 ft. Salt thicknesses range in the same portions from 0 to 1,800 ft. Stringer systems are rather elaborate and should be fairly predictable within the syncline. Good to very-good capping formations are in evidence, being mainly evaporative-type rock. Some shales show in the salt-bearing areas. Three general salt sections exist and are commonly known as "Section B, Upper A, and Lower A." Three operators are in the Michigan basin area and one operator is in Canada. Total storage of the Michigan basin wells is approximately 425,000 bbl.

Drilling techniques and casing strings are straightforth and little different from those of the Permian basin. Washing techniques would most logically be of the bottom-hole type, or of the floating-hanger and blanket type. Drilling and production difficulties would be similar to those of West Texas. Little is known about recovery experience. Wells are located on the skirts of the syncline, where depths to salt sections are not excessive. But nothing would prevent the operator from moving inward to a point where greater thicknesses of salt sections would be available.



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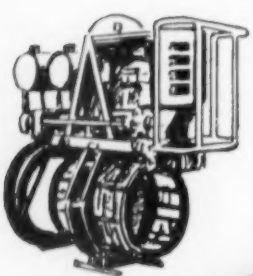

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Let's review the basics of . . .

Controlling pulsations in gas piping systems

by C. Newman and N. H. Moerke

Resistive or reactive? High-pass or low-pass? Which dampener should be used? Check this article for general characteristics of pulsation dampeners and the advantages of each.

GAS pulsations in reciprocating compressor service result from the periodic intake and discharge of gas from compressor cylinders. This action of the compressor cylinders sets up waves of gas compression and rarefaction that travel through the piping system at the velocity of sound.

Field measurements have shown that the amplitude (peak to peak) of the gas pulsations in the nozzles of the cylinders for compressors used for gas-transmission purposes is in the range of 6 to 10 per cent of the operating pressure for normal compressor operation. During abnormal operation, the gas pulsations can be higher than the normal 10 per cent.

Pulsative waves induced by reciprocating action of compressors are capable of setting up vibrations in the piping at locations within the compressor-plant area and also some distance from the compressors. These vibrations can be, and are, very serious when the natural frequency of a span or configuration of piping is equal to the frequency of the pulsations. When these phenomena occur, the periodic forces of the pulsations get into step with the natural vibrational period of the piping and reinforce the vibrational displacement. This reaction results in the generation of extraneous noise and dynamic stressing of the pipe, with subsequent fatigue failure of the piping system.

Gas pulsations often adversely affect the accuracy of orifice-plate flow measurement. In some cases, the presence of pulsations cause the pens on flow recorders to oscillate to the extent that it is difficult to determine an accurate average. In other cases, the recorder pens are damped to the extent of drawing a smooth line on the chart, but an error in flow measurement still exists.

Methods of Control

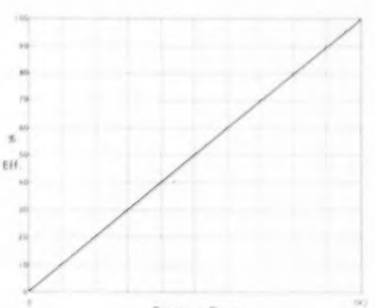
The magnitudes of gas-pulsation problems are difficult to predict before a compressor plant is placed in operation. In many cases, otherwise well-designed plants have received unfavorable criticism from operators and management because of operating difficulties caused by the presence of excessive gas pulsations under actual operating conditions. However, through the diligent use of dynamic relationships[1] in the design of compressor-plant piping and pulsation-dampening equipment, the problems attributed to gas pulsations can be minimized.

There are two basic ways of controlling these gas pulsations:

1. Resistive. Methods whose efficiency is a function of pressure drop and which consist of a reduction in area of the flow path by means such as orifice plates and valves.

2. Reactive. Methods whose efficiency is a function of frequency and which consist of properly designed changes in pipe sections and internals such as low or high-pass dampeners.

Resistive types . . . These methods of controlling gas pulsations have been used in the past and are occasionally found in present-day plants in the form of orifice plates and pinched valves. However, general use of this type control is not recommended unless it is designed for a specific purpose. It has certain disadvantages which override its advantages of low initial cost and small physical size.



RESISTIVE DAMPENER has straight pressure-efficiency characteristic. Fig. 1.

These disadvantages are that its efficiency is a function of the gas-pulsation amplitude, with generally low efficiency and high resistance to flow, or high-pressure drop. A graph is presented, Fig. 1, which shows a typical curve for efficiency versus pulse pressure for this type of control method on gas pulsations.

The simplest form for this control device is a valve placed in the system at the point which requires control. The more elaborate form, which requires a knowledge of design, is the placing of an orifice within a volume chamber.

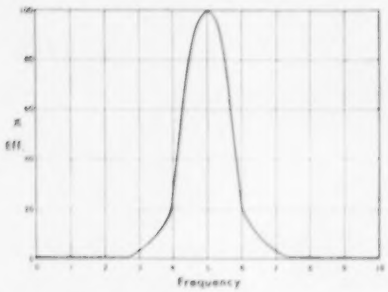
Reactive types . . . These methods of controlling gas pulsations are presently in use on systems where reciprocating compressors are used to compress and transport gas. The basic reactive type dampener is used in three major ways: (1) side-branch resonators; (2) high-pass dampeners; and (3) low-pass dampeners.

. . . Side-branch resonators are absorption devices which give negligible pressure drop to the system, but have a limited frequency range and can be used to advantage on essentially constant speed compressors. Fig. 2 is the characteristic attenuation curve for this type of pulsation control.

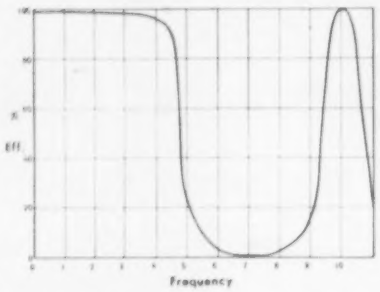
The forms of this type of control device are composed of volume chambers and orifice plates, volume chambers and pipe lengths, or just pipe lengths all of which can be attached to the laterals, headers, or normal surge chambers of the compressors at a side branch.

. . . High-pass dampeners are dampeners which allow passage of the high frequencies and attenuate the low frequencies. They can be designed to have low-pressure drop with high attenua-

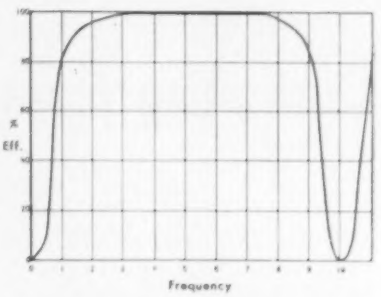
Authors are chief engineers with Fluor Corp., Ltd., and are located in Los Angeles and Paola, Kans., respectively. Paper presented at the American Society of Mechanical Engineers' petroleum mechanical engineering conference in New Orleans, September 25-28.



RESONATOR has narrow range, works best with constant-speed compressor. Fig. 2.



TYPICAL characteristic curve of high-pass dampener. Fig. 3.



LOW-PASS dampener characteristic, showing recurrent pass-band. Fig. 4.

tion characteristics for pulsation control. Fig. 3 shows a typical curve for efficiency versus frequency for this type of control method. In order to show the recurrent characteristic, the curve is drawn arbitrarily showing a recurring attenuation peak at 10 cycles. This recurrent characteristic is a function of the physical geometry of the dampener.

The forms of this type of control device are composed of a length of perforated pipe and external shell which can be inserted in the lateral (in-line dampener) or replace the normal volume (manifold dampener) bottle of the compressor.

. . . Low-pass dampeners are dampeners which allow passage of the low frequencies and attenuate the high frequencies. These also can be designed for low-pressure drop with high attenuation characteristics for pulsation control. Fig. 4 shows a typical curve for efficiency versus frequency for this type of control method. In order to show the recurrent characteristic, the curve is drawn arbitrarily showing a pass frequency at 10 cycles. This recurrent characteristic is a function of the physical geometry of the dampener.

The forms of this type of control device are composed of two chambers and interconnecting pipe and can be adapted to almost any configuration. The manifold configuration is designed so that one chamber of the dampener is used as the volume bottle for the compressor cylinder, replacing the normal volume bottle. The in-line dampener consists of an elongated shell which is divided into multiple chambers with appropriate interconnecting tubes. It is inserted in the lateral piping as close to the compressor as possible.

The two-bottle dampener consists of two separate chambers which are connected by a properly sized interconnecting tube, with one chamber used as the manifold volume bottle while the second chamber is inserted in the lateral.

The dampening system, which considers the complete plant piping between the compressor cylinders and header system as a pulsation dampener, requires the proper relationships between volume bottles, headers, and lateral piping.

Characteristics of Control Methods

Table 1 is a tabulation of the general characteristics of the various methods of controlling pulsations. Each method has a definite use dependent upon the existing circumstances surrounding the pulsation problem. The high-pass and low-pass dampeners have the wider utility, with the low-pass dampener being the more adaptable to various design situations.

Figs. 3 and 4 show more clearly the recurrent characteristic which is tabulated as a disadvantage in Table 1. This recurrent characteristic is a function of the geometry of the dampener, and its magnitude and frequency is not always predictable by simplified theories.

Residual-Pulsation Limits

Invariably during conversations or discussions regarding control of pulsations, someone will ask the question, "How much control or damping is required to prevent vibration or metering errors?" This question is difficult to answer specifically. Each type plant is slightly different in design as to compressors, piping, etc. However, some general areas of acceptable residual-pulse pressures can be worked out.

For plants where vibration is an expected or a prevalent problem, the areas fall into two categories dependent upon the basic plant design. In plants which follow the pattern of grade-type piping and which are well designed in accordance with dynamic relations for structural supports, 1¼ per cent (½ peak to peak) of average pressure is acceptable. Where plant design follows the pattern of overhead-type piping, there is more room for errors in dynamic relations of the structural supports. So we have two regions of acceptability: 1¼ to ¾ per cent (½ peak to peak) of average pressure for well designed and ¾ to ½ per cent (½ peak to peak) of average pressure for average design.

For plants where metering problems exist or are expected, the maximum residual pulse pressure ranges from ¾ to 1/10 per cent (½ peak to peak) of average pressure and is dependent upon type and range of the meter and its position in relation to compressors.

Reference

1. Correction and Prevention of Engine Piping Vibrations, by N. H. Moerke and C. Newman, Proceedings, twenty-eighth annual fall meeting of the California Natural Gas Association, October 8-9, 1953, pp. 37-46.

TABLE 1—GENERAL CHARACTERISTICS OF VARIOUS-TYPE DAMPENERS

Type dampener—	Advantages	Disadvantages
Resistive	Essentially insensitive to frequency.	Low efficiency, high-pressure drop.
Resonator	Negligible pressure drop, high efficiency.	Limited frequency range. Limited configurations. Requires constant-speed operation.
High pass	Low-pressure drop, high efficiency, wide frequency range.	Passes high frequencies. Recurrent dampener. Limited configurations.
Low pass	Low-pressure drop, wide frequency range, high efficiency, adaptable to many configurations.	Passes low frequencies. Recurrent dampener.

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Among the Drilling Contractors

Littlefield Made Head of South Louisiana Drillers

Baker Littlefield, Power Rig Drilling Co., Lafayette, has been elected chairman of the South Louisiana chapter of the American Association of Oilwell Drilling Contractors for the ensuing year.

Other new officers include: R. V. Pierce, Wheless Drilling Co., Houma, vice chairman; and J. B. Hamilton, W. C. Fatjo Drilling Co., Lafayette, secretary-treasurer.

First regular meeting of the chapter under the new officers is scheduled for November 17, other regular meetings have been set for January 25, March 28, and May 23, next year.

Glasscock-Wilson, Inc., Shreveport, will drill a 10,500-ft. test for Hassie Hunt trust in the Rousseau area, Lafourche Parish, Louisiana Gulf Coast. Location is at 1 Bouvier et al, in 57-15s-17e.

Bush Drilling Co., Lafayette, La., is moving a rig to an outpost location in the Cow Pen Creek area, Beauregard Parish, southwestern Louisiana, where it will drill a 6,950-ft. test for Mound Co., of Houston. Spot location is in 17-6s-9w.

Crawford Drilling Co., Shreveport, has a new wildcat operation scheduled for Smith & Cameron, of Shreveport, in Concordia Parish, eastern Louisiana. It is a 6,800-ft. Wilcox test at 1 Madison, in 35-6n-8e, about 15 miles southwest of Vidalia, La., across the Mississippi River from Natchez, Miss. Location is a little more than 3 miles northwest of Deer Creek field, and about the same distance northeast of Quinn Bayou field.

New Drilling Co., Denver, is contractor and joint operator with C. G. Novotny on a new wildcat operation 1½ miles northeast of Shorts field, in Cheyenne County, southwestern Nebraska. Location is at 1 Rudolph, in 9-13n-51w.

Delta Drilling Co., Tyler, Tex., is a partner with Diablo Drilling, Inc., in a new wildcat operation 2 miles northeast of Merino pool, in Logan County, northeastern Colorado. Delta is doing the drilling. Location is on state land, in 9-6n-53w.

Power Rig Drilling Co., Lafayette, La., is keeping a rig busy for Magnolia Petroleum Co. in the Clear Creek area, Beauregard Parish, southwestern Louisiana. Newest contract calls for a 9,500-ft. test at 1 Robinson, in 2-6s-8w, about ½ mile from nearest well on the north side of the field.

Pernie Bailey Drilling Co., Houston, is getting under way at a 9,800-ft. wildcat test 6 miles northwest of Beeville, in Bee County, South Texas. It is a contract job for Dakamont Exploration Corp., also of Houston, at 1 Martin, in the W. Simms Survey. Lo-

On the floor of a rig Coppinger Drilling, Inc., Wichita, Kans., is operating in Garfield field, southwest of Larned, in southern Pawnee County, Kansas, on the west flank of the Central Kansas uplift. Left to right: Pat Clowers, geologist; W. L. Hayden, roughneck; Jack Johnson, driller; O. E. Owens, tool pusher; Adrian Freeman, and John Grimes, roughnecks.

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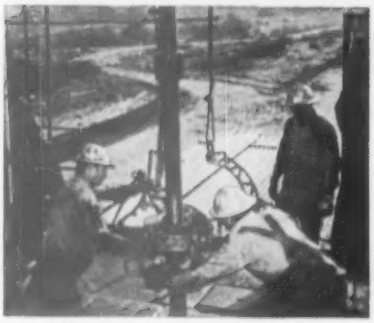

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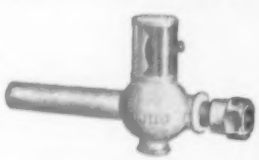

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cation is 1½ miles southwest of a 9,200-ft. discovery well completed by Holmes Drilling Co. early this year.

Petersen Drilling Co., Shreveport, has a rig running for Plymouth Oil Co. at a wildcat location 4 miles southeast of Spanish Fort, in Yazoo County, Mississippi. Permit calls for a 7,000-ft. test at 1 Pennell-E. L. Bruce Co. in 11-10n-5w.

Commonwealth Drilling Co., Ltd., Calgary, is scheduled for another well in the Westward-Ho area of Alberta Province, to confirm the new gas discovery made by Oilwell Operators, Ltd. Its new location at 1-7 Harmatton, in LSD 1, 7-32-4w5, is about ¾ mile northwest of the discovery well.

Makin Drilling Co., Hobbs, N. M., has contracted with Cities Service Oil Co. for another deep test in Lovington field, in Lea County, New Mexico. Location is for 1 State "AD," in 1-17-36, about 6 miles southeast of the town of Lovington. Plans call for an 8,300-ft. test.

Martin Connection Works, Laurel, Miss., will drill the new 6,500-ft. Eutaw test Texas Crude Oil Co. is undertaking in the Big Creek area, 7 miles southeast of Clara, in Wayne County, eastern Mississippi. The operation will be at 1 Palmer-Jones Unit, in 24-6n-7w.

Miller Brothers & Bowling, Alice, Tex., have a new operation under way in the general Olivia area, of Calhoun County, where they are drilling under contract for Southern Minerals Corp. and Seaboard Oil Co. The new test, at 2-A Traylor, is 2 miles west of town.

John S. Hagestad Drilling Co., Bakersfield, Calif., is under contract to Moriqui Exploration Co. for a 7,200-ft. wildcat test in the Famoso area, 20 miles north of Bakersfield, in Kern County, California. Location is for 87-25 KCL, in 25-26-25.

C. G. Glasscock Drilling Co. has a new water-located job coming up for Republic Natural Gas Co. It will be a 9,000-ft. test off the coast of St. Bernard Parish, Louisiana, in Breton Sound. Location is on Republic's State Lease 2464, in Block 1.

Blanton Drilling Co., Houston, has a new wildcat operation under way in northern Harris County, Texas Gulf Coast. It is a 6,200-ft. test for Christie, Mitchell & Mitchell at 1 Kovack. Location, in the John Shaw Survey, is 4 miles southwest of Tomball, and about 1¼ miles south of Tomball field.

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McCullough's simultaneous logging equipment is available in an increasing number of service areas. Ask your nearest McCullough Branch for details.

McCullough Radiation Well Log Picks Up Four Foot Pay Zone . . . . . Glass Jets Perforate for 240 B/D

A fine example of the accuracy of the McCullough Radiation Well Logger in locating, defining and interpreting the nature of a thin productive zone so that it could be perforated for maximum production, has just been reported from a Kansas oil field.

This was a new well. 5½" O.D. 14 lb. casing had been set to bottom. McCullough ran a Radiation Well Log obtaining Gamma Ray and Neutron curves and recording a simultaneous collar log.

The log revealed a thin, four foot zone at 3856' and indicated that it was productive. The interval was shot from logging curves and collar log measurements with McCullough's 4" O.D. Super Casing Glass Jets in Steel Strip Carrier, four holes per foot. Total logging and perforating time was only three hours.

After perforating, the well had a good show of oil. Zone was treated with acid and made 240 barrels per day on test, which was a very good well for the field.

The McCullough Radiation Well Logger is the most accurate, reliable and efficient logging instrument available. It has greater stability, provides more detail and assures more accurate quantitative interpretation.

Because of the extreme efficiency of the scintillation counter in detecting radiation and because of its very short length, it is possible to log beds as thin as 12" with clarity and accuracy.

Whether the pay zone be thick or thin, the simultaneous recording of a collar log means placing the perforations exactly where they are wanted . . . fully covering the productive formation.

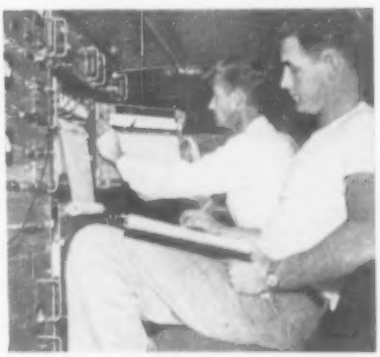
McCullough Log Finds Ten Feet of Pay Behind Casing

Sixteen Standard Casing Glass Jets Shot in 10' of Cased Off Pay Zone Increase Production from 5 B/D to 30 B/D

Many times the McCullough Radiation Well Logger has been instrumental in turning a poor producer into a profitable operation. While this Oklahoma well was a small producer even at its best, the 500% increase in production gained through the use of McCullough Logging and Perforating Services meant the difference between loss and profit.

The operator had set 4½" O.D. 9.5 lb. casing on top of the pay zone. The interval was treated but the resulting 5 barrels per day of production was considerably below the average for the field.

McCullough was called to run their Radiation Well Logger. Gamma Ray and Neutron curves were obtained along with a simultaneous collar log. It was found that 10' of pay zone lay behind the casing at approximately 1645'.



Interior of McCullough Radiation Well Logging Truck showing electronic instrumentation, controls, recorder, etc. At this panel down-hole information is evaluated and recorded with extreme accuracy.

Sixteen shots were fired in the 10' interval by a McCullough Standard Casing Glass Jet Perforator with Steel Strip Carrier. The well is now making 30 barrels per day—a good well for the field. Total time on the job for both logging and perforating was one hour, twenty minutes.

As a result of the success of this job the operator is now logging and perforating all his wells in the area.

It always pays to call McCullough. You can be sure of exactly locating and defining potentially productive formations. You can be sure of deep, uniform penetration of the pay zone by the "world's hardest shooting perforators."

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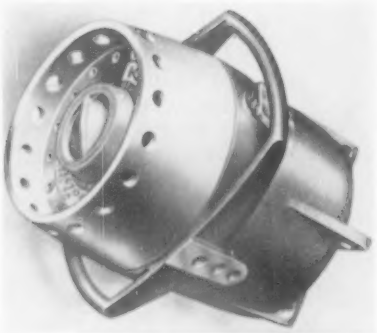

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A portable gamma-ray projector is being made in three sizes, 75 lb., 250 lb., and 2,900 lb. It is extremely safe to operate and costs only a fraction as much as comparable X-ray equipment. It is also extremely portable, needs no electricity or control board or maintenance beyond replenishment of the radioisotope, and can take a picture of 360°. When the shutter is closed the shielding is so thorough that men literally can work on top of the unit in complete safety. Even photographic materials can be brought near it without fogging.

The Kel-Ray gamma-ray projector is shielded with lead. The thickness of its walls depend on the strength of the isotope to be employed. It has a lensless shutter that can be opened and closed remotely. The projector is charged in a radioisotope laboratory by inserting a capsule that contains the proper amount of the radioactive isotope, called a source. Gamma rays escape from the small capsule and fill the camera's chamber, but are held in check by the lead walls.

When welding of a large vessel is finished, for instance, segments of conventional X-ray film are placed around the weld on the outside of the tank in a continuous belt. The projector is positioned inside the vessel and opened for the proper exposure time. Immediately after exposure, the film is developed on the spot and examined for construction flaws while the welding crews are still there. **For more information write or call: The M. W. Kellogg Co., 225 Broadway, New York 7, N. Y.**

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received. An increasing flow rate increases the number of downstream pulses and decreases the number of upstream pulses. The repetition rate of these pulses cancels out sonic velocity by heterodyne techniques, leaving only the difference in repetition rate which is proportional to flow velocity.

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a large percentage of beam dispersion by solid particles or air bubbles. This also automatically adjusts for variation in sonic attenuation caused by different fluids.

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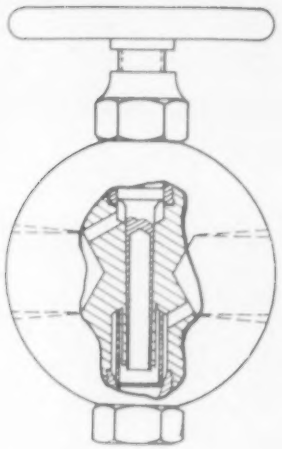
Type ER-A (illustrated) is a wire-line retrievable valve for side-pocket mandrels. It is fitted with Chevron packing, has an integral reverse-flow check valve, and a male-threaded top for regular latching tools. In addition to the Type ER-A valve, which is an unbalanced intermitting valve, the Type ER-ACF (continuous flow), and Type ER-ABP (balanced intermitting) are also furnished for side-pocket mandrels. For standard mandrels with external mountings, the piston valves are furnished in types A, A-CF, and A-BP-2, in standard and junior sizes. Similar valves are furnished for use in sliding-sleeve valve mandrels, in which the gas-lift valves are wire-line retrievable, and are internally mounted, concentric with the tubing bore.

Field maintenance, including recharging, is simplified. All working parts can be replaced in the field, using standard hand tools. The pressure that is inserted between the sealing O-rings on the piston can be varied to meet requirements; as a consequence, extremely high operating pressures can be used and the valves can be submerged to any depth without damage. **For more information write or call: Garrett Oil Tools, Inc., Box 2427, Longview, Tex.**

Pressure-Gage Snubber Utilizes Pulsations

New VP adjustable-type pressure-gage snubber utilizes the pulsations of the operating pressure to help dampen pulsating pressure.

The snubber features a long, hollow, piston-type damping plug with very



thin walls which flex slightly during each pulsating pressure cycle. The damping plug is adjustable and has a slight taper which fits into a matching taper in the body.

For any given application, the required clearance, or restriction, is established between the tapered surfaces of the damping plug and body by adjusting the damping plug. The full, or unrestricted force of each pulsation enters the open end of the damping plug which expands the thin walls slightly, the effect of which momentarily decreases the clearance and increases the restriction between the tapered surfaces of the damping plug and body during the pulsation cycle.

The snubber is furnished with a stainless filter, and a simple means for removing same for cleaning and replacement without disconnecting the snubber from the line of service.

The snubber is small and compact. Body length of the ¼-in. size is 1½ in. and of the ½-in. size is 1⅞ in. Operating pressure rating is 6,000 psi. Standard snubbers are made of brass and Type 304 stainless steel. Both units have Type 321 stainless steel damping plug and stem. **For more information write or call: Velotrol Corp., 428 West Eighth Street, Bartlesville, Okla.**

●

Converter Transforms Card Data Into Analog Signal

The Librascope punched-card converter, Model 250, is an efficient, automatic data-processing accessory that translates the decimal code punched into cards into an analog signal for automatic point plotting by Librascope X-Y plotter and recorder Model 200-A.

The punched-card converter is a precision-relay converter that will accept digital information from various types of IBM equipment and transforms digital information to a resistance divider suitable for input to the X-Y plotter. The converter will also accept similar information from the Librascope Model 227 decimal keyboard as an aid to calibration.

The punched-card converter has an accuracy of 0.1 per cent when used alone and an accuracy of 0.25 when used in conjunction with a plotter. When used with the X-Y plotter the instrument will plot approximately 60 cards per minute. When used with IBM punch machine 523, cards are simply loaded into the hopper, no special panel connections being necessary.

Individual punched cards may be read separately on a visual display located on the front panel of the instrument. The chart scale of the converter can be expanded independently by a

16" and 20" HIGH-PRESSURE GAS LINES MODIFIED *in service*

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USES WmSON STOPPLE* TO FACILITATE INSTALLATION OF BLOCK VALVE ON THEIR 20" GAS TRANSMISSION LINE *WITHOUT INTERRUPTION OF GAS SERVICE TO THE CITY OF DENVER*

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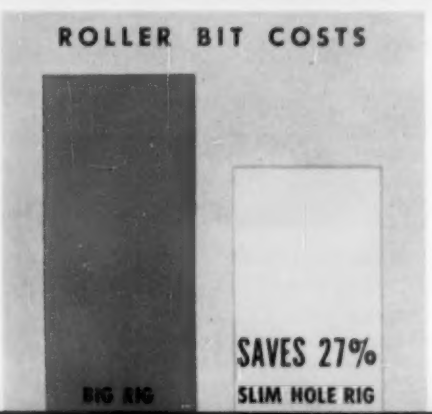
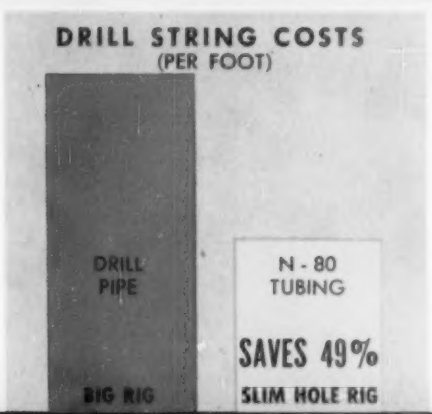
HOW SLIM HOLE Contractors :8 ways smaller,

Lighter weight Slim Hole rigs can be moved with fewer loads for less. The difference in moving costs can mean the difference between profit and loss. Slim Hole rigs frequently weigh less than half that of conventional rigs. A 10,000 "big" rig moves in 20 loads or more... the smaller rig requires 7 to 9 loads in most states.

Slim Hole rigs can be rigged up in less than a day's time. In fast digging areas, where rig-up and moving time often consume up to 25% of total well time, a 50% reduction in rig-up time alone could save large sums of money each year.



As a general rule, Slim Hole bits cost 20% to 30% less. Recent bit improvements in Slim Hole sizes appear to be giving almost as much footage per bit as corresponding big bits, making the Slim Hole bit cost comparable, and in many cases less.



In most areas, a tubing drill string should last almost as long as 4½-inch drill pipe, provided the contractor exercises appropriate care. On the average, contractors can expect important savings ranging up to 50% using N-80 tubing.

DON'T GO INTO SLIM HOLE DRILLING "BLIND"

Your copy of "Slim Hole Facts" is now off the press. This 150-page book will give you the latest factual information on how Slim Hole drilling can save you money. For your free copy, please contact your nearest Cardwell representative, or write Philip L. McLaughlin, Drilling Research, Cardwell Manufacturing Company, Inc., Box 2001, Wichita, Kansas, on your company letterhead.

CAN CUT daily drilling costs . . .

less expensive equipment can lower costs

DAILY RIG COSTS

Smaller rigs require low initial investment, depreciation, insurance, taxes, and maintenance. Such rigs can be operated with 4 and sometimes 3 men—thus reflecting considerable saving in labor. Because of lower daily costs, considerable savings can be effected. As an example, if a "big" rig can drill a well in 10 days, a Slim Hole rig could take 23 days before drilling costs become equal.

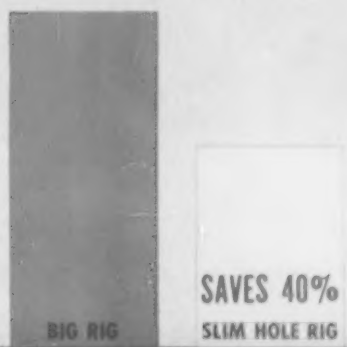
DEPRECIATION
INSURANCE AND TAXES

Being lighter, smaller, and generally simpler, Slim Hole rigs usually cost considerably less than "big" rigs. Sometimes this cost differential is less than expected because some Slim Hole rigs are wheel-mounted, or self-powered, and often have special equipment to reduce rig-up time. In most instances, a Slim Hole contractor may anticipate a lower capital investment, lower depreciation, and insurance rates.

FUEL COSTS

Fuel savings of 25% to 60% might be expected using Slim Hole rigs, depending on per cent load factor and pump requirements for the given area. Compound Slim Hole rigs rarely need more than half as much peak power as "big" rigs rated for same depth.

REPAIR COSTS



Slim Hole contractors report that one-third savings in repair costs might be expected when compared to the larger, more complex mechanism of "big" rigs. This saving depends on drilling conditions, the contractor and his personnel.

CARDWELL now has many rig combinations available for Slim Hole Drilling From this line of equipment, a contractor, operator, or workover contractor may select either compound or split rigs, either wheel-mounted or skid-mounted assemblies. He can choose a wide variety of drives, masts, engines, pumps, or air compressors. See your nearest Cardwell representative, or write Cardwell for complete information on Slim Hole rigs.

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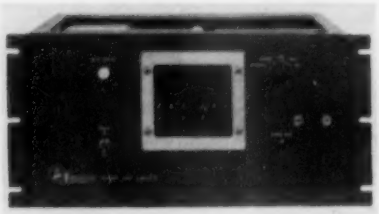


factor of 10 to 1 for special-data process appliactions. The unit measures 23⅞ in. long, 16¾ in. wide, 12¾ in. high, and weighs 68 lb. **For more information write or call: Librascope, Inc., 808 Western Avenue, Glendale, Calif.**

●

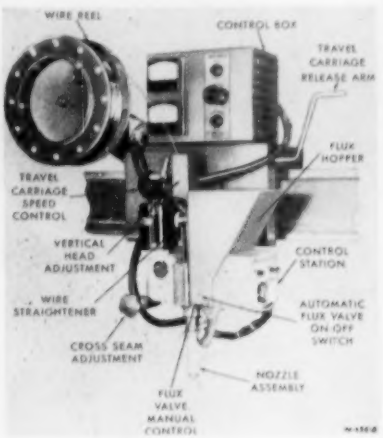
New Equipment Improves Hidden Arc Welding

A new line of equipment for hidden or submerged arc welding includes three new welding heads, new controls and adjustments, new accessories, and two new power sources.

The new welding heads—LAF-3, LAF-4, LAF-5—offer users a choice of heads for either a.c. or d.c. current, field or shop welding, and constant-potential or variable-voltage power source. New operation controls permit (1) a choice of instantaneous starting, either hot for intermittent welding or cold for precision starting; (2) a choice of variable inching speeds, either slow or fast, away from or to the work; and (3) a choice of carriage operation to give stand-still starts, flying starts, or manual control. Flux-flow start or stop is controlled either automatically or manually. Field operation is possible from engine-driven welders without use of additional line power.

In addition to heads, mounting equipment is available to give either a stationary mounting, mounting on a self-propelled travel carriage, or on a self-propelled tractor. The heads can be adapted for Twinarc or tandem arc welding or for an oscillating attachment.

A new Lincolnweld power source has been added to the line in the Lincolnweld AC-750, which gives 750-amp. continuous-duty a.c. power.



Another new power source is the Lincolnweld DC-750, which is a motor generator machine specifically designed for automatic welding. It is rated at 750 amp. for continuous duty at 40 volts. It can also be paralleled with a second DC-750 for work requiring higher amperages. **For more information write or call: Lincoln Electric Co., 22801 St. Clair Avenue, Cleveland 17, Ohio.**

●

Whipstock Milling Cutters Speed Window Cutting

New milling cutters use a new cutting principle and a new, superhard carbide material called Servcoloy. Primary advantage of the new tools is faster cutting. Numerous windows have been cut with these mills in less than 12 hours—some as fast as 6 hours.

A combination of matrices and carbide particles provide hundreds of cutting edges in contact with the casing at all times. As particles are dulled or worn away, new cutting particles take their place. This self-sharpening action provides smooth, fast cutting and eliminates the torque and hanging-up prevalent in other knife or blade-type milling tools.

The new mills are also provided with back-cutting lobes, located on the top portion of the mill body. These lobes also contain carbide particles and are used to smooth rough edges formed in the window. By doing so, they prevent the mill from hanging up when coming out of the hole and provide a smooth surface for subsequent runs.

In a normal window-cutting job, only two types are required. The CF-type mill starts the window and makes approximately 2 ft.; the CA-type finishes

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the operation. **For more information write or call: Servco Co., 904 Security Building, Long Beach 2, Calif.**

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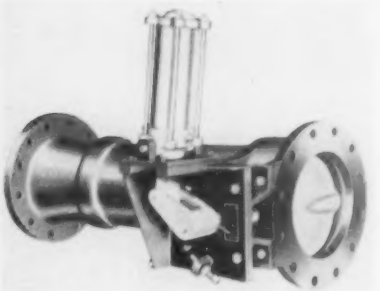

Rate-Of-Flow Controller Assures Tight Closing

The power-actuated rate-of-flow controller is designed for the effective operation of water, waste, or industrial plants.

The controller comprises a venturi metering section and a pressure-recovery section, a power-actuated valve mechanism, and a pneumatic, hydraulic, or electric-positioning control unit. Its cast-iron body, for 125 psi., has a pressure-averaging annulus at the inlet and a closed annular chamber with multiple vents at the throat. The bronze-lined venturi throat section is of proper diameter and contour for maximum accuracy and for insuring freedom from corrosion and tuberculation. The Model RCB-T comes equipped with a rubber-seated butterfly valve for tight closure.

Prime advantages include: (1) high control accuracy within ± 3 per cent ranging from 25 to 100 per cent of maximum capacity; (2) long-life body, generous use of bronze and stainless steel; (3) rugged construction of valve and operating parts; (4) convenient installation providing maximum utility of space; (5) simple design, featuring one-piece, cast body construction; and (6) low head loss. **For more information write or call: Builders-Providence, Inc., 345 Harris Avenue, Providence, R. I.**

●

Spray-Mastic Developed To Protect Insulation

Spray-Mastic is a protective, asphaltic coating compound of a special-chemical dispersion type. It is considered superior to cutback asphalts which contain flammable solvents as carrying agents, and to water emulsion compositions.

The new protective coating is easily sprayed on with any conventional type roofer's or undercoater's spraying

equipment, and the sprayability of Spray-Mastic is virtually unaffected by temperature between 40° and 140° variation. It provides excellent stickability when applied to most insulations as well as metals and other building materials. The coating readily builds up to a ⅛-in. thickness.

Freezing temperatures do not affect Spray-Mastic. Even in temperatures below zero, the material does not break down or separate, nor does it settle out, which means that it does not require the addition of materials or accessory spraying equipment. When dried and cured, Spray-Mastic offers great resistance to the attacks of chemicals common to many industrial operations.

The new spray-on protective coat for insulation dries to the touch in 4 hours. It remains pliable indefinitely. It retains this pliability under all types of atmospheric and climatic conditions. One gallon will provide a dry coating ⅛-in. thick over an area 20 ft. square. **For more information write or call: The Eagle-Picher Co., Advertising Department, 900 American Building, Cincinnati 1, Ohio.**

•

New Tool Repairs Or Recovers Casing

This new casing-hanger and casing-bowl combination offers the simplest, safest way to repair damaged pipe or recover casing from old wells. Operators can salvage the overlapped casing in old oil wells by splicing casing with this combination hanger-casing bowl and place the well on production with the same tension on the casing as before the salvage operation took place.

The combination is used extensively as a casing-patch tool and requires no cementing to form a seal or overlap casing to the surface. No rotating of patch is required. Just let down and pull up to effect the seal. Repair operations can effectively be made at a point below the casing-bowl setting.

These tools utilize safety-slip construction assuring 100 per cent contact with the casing and a full backup support to each slip. **For more information write or call: Burns Tool Co., 8346 Salt Lake Avenue, Bell, Calif.**

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Dehydration of Air and Gas with Davison Silica Gel. Technical bulletin No. 201 is a report on research in the field of dehydration conducted by Southwest Research Institute, a natural-gas plant, and Davison laboratories. Graphs show typical equilibrium adsorption capacities of silica gel and other desiccants. Eleven graphs illustrate advantages of silica gel in dehydration. **For more information write or call: Davison Chemical Co., Baltimore 3, Md.**

•

Control of Corrosion on Underground and Submerged Structures. This new two-color booklet is divided into three sections: Dow magnesium anodes; engineering and contracting service; and a complete line of cathodic-protection material. The first section illustrates the action of magnesium in stopping corrosion and lists the applications for magnesium anodes. The section on engineering and contracting service includes an anode selection chart and installation data. **For more information write or call: Corrosion Services, Inc., P. O. Box 7343, Tulsa, Okla.**

•

How Edwards Wire Rope Is Made is the title of a new 28-page illustrated booklet. It describes and illustrates the various steps involved in the manufacture of wire rope. These include heat treating, cleaning, wire drawing, reheating, recleaning, final drawing, galvanizing, testing, tagging, storage spooling, stranding, and closing. The booklet presents a detailed description of the development of endless wire of uniform structure into the finished wire rope. **For more information write or call: E. H. Edwards Co., Butler Road and Industrial Way, South San Francisco, Calif.**

•

Motor-Driven Controlled Volume Pumps. New four-page, two-color Bulletin 955 describes latest addition to the company's line of controlled-volume pumps for low-capacity flow control. The brochure details operation of a stroke-length-adjusting air servo sys-

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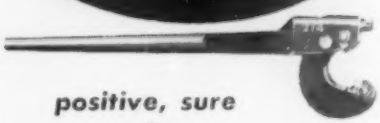

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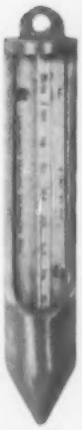
Laboratory Core Drills

For cutting sample plugs from oil well cores. Also may be used for drilling holes in cores.

Bit is made of chromium molybdenum steel with an annular crown of industrial diamonds mounted in a matrix of cemented carbide on the cutting end. In order to insure concentricity, all machining is done after diamonds are mounted on the bit. Standard length allows drilling to 3-inch depth.

Thermo-Plumb Bob

Carries down tape — reads oil temperature — measures water in tank bottom. A six-inch, 15-ounce brass plumb bob, hollowed out to form an oil cup, and equipped with thermometer for reading temperature of oil. On back of plumb bob is a 6-inch scale which can be used to gauge the amount of water in the bottom of the tank by use of Gage-O water finding paste.



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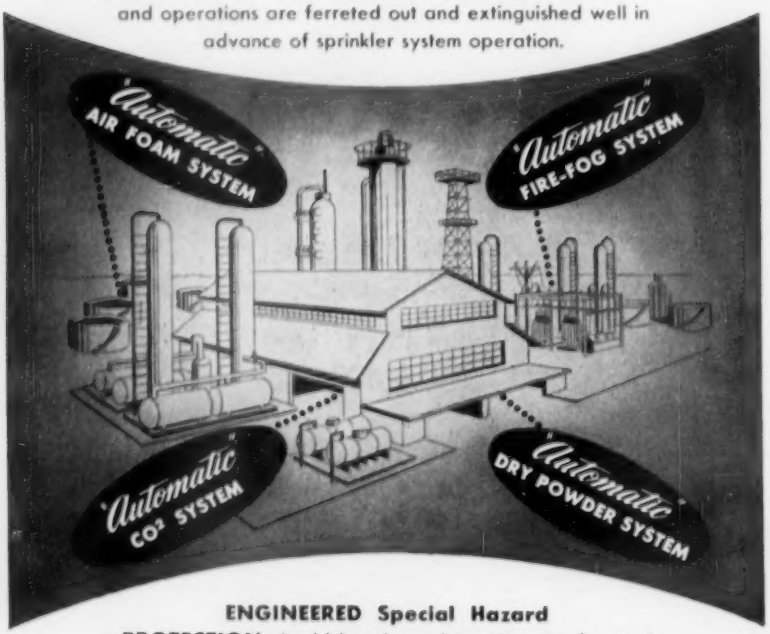

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tem, and includes information on application, features, and specifications. Diagrams are given showing major components of the unit, and also detailing its application and hookup in a typical pneumatic flow-control system. **For more information write or call: Milton Roy Co., Station O, 1300 East Mermaid Lane, Philadelphia 18, Pa.**

•

Rubber-Lined Valves, a handy, four-page condensed bulletin, deals exclusively with the hard-rubber-lined gate and check valves for corrosive services. These valves are made in many metals, alloys, and various types for special service requirements. However, the economics made possible by the use of iron-body, rubber-lined valves in many corrosive services have stimulated widespread interest. The bulletin contains tables giving the range of sizes available and complete dimensions for both rubber-lined gate valves and rubber-lined horizontal swing-check valves. **For more information write or call: Darling Valve & Manufacturing Co., Williamsport, Pa.**

•

Serving the Oil Industry for Over Forty Years. A special brochure has been prepared describing the applications of Hexteel and Floorsteel in the petroleum industry. Hexteel is a steel retainer for refractory. Floorsteel is especially applicable to pipe linings, heads, plenum chambers, sumps, stacks, and furnaces. It is used in conjunction with Hexteel for lining extremely small diameters, difficult contours, and irregular surfaces. Specifications, general data, characteristics, and applications are thoroughly outlined in the brochure. **For more information write or call: Klemp Metal Grating Corp., 6609 South Melvina Avenue, Chicago 38, Ill.**

•

How Your Weight Indicator Works is a nontechnical discussion of weight indicators for the man on the rig floor. Bulletin P-34 objectively tells the pros and cons of different kinds of weight indicators and the applications for which they are best suited. It discusses simple hydraulic principles and factors that affect weight indicator readings. **For more information write or call: Martin-Decker Corp., 3431 Cherry Avenue, Long Beach 7, Calif.**

•

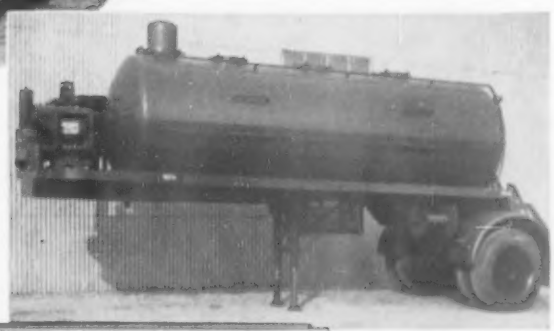
The Dorrco D-Sander. A new, six-page, two-color bulletin N-2506 details the physical characteristics, components, sizes, capacities, and operating advantages of this newly developed unit for the removal of sand from rotary drill

MOVING DRILLING MUD *FAST!*

Just for the record, this moving job during a changeover was timed, and here are the results: Exactly 8 minutes, 33 seconds after the driver yanked up on the emergency brake, 45 bbls. of 12 lb. mud was snugly inside the Thompson Unitized Vacuum Tank!

TO THE NEXT HOLE

From there to the next hole was discounted as driving time. Starting the stop watch again when the driver had backed up to the shaker pit, the one man laid hose, opened the valve and had the tank empty in 4 minutes 10 seconds.



This new Vacuum Tank Trailer, complete with engine and pump, is now available. Write for specifications and price!

GET ALL THE FACTS

There's a Thompson Unitized Vacuum Tank built to do your jobs fast, too! Cleaning tanks, draining sumps, pumping out cellars, agitating mud, spraying roads, weeds, etc., are everyday chores for this workhorse. Check UVTs: 20-100 bbls. capacity; truck, trailer, semi-trailer or skid mounted.

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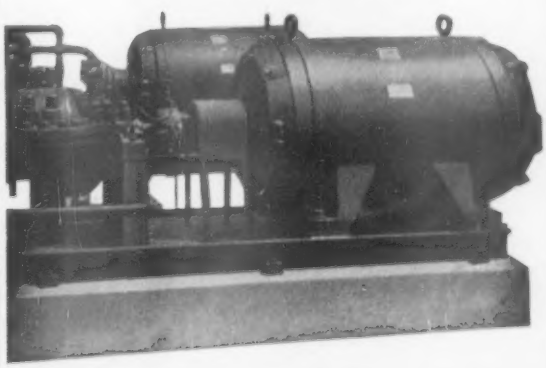
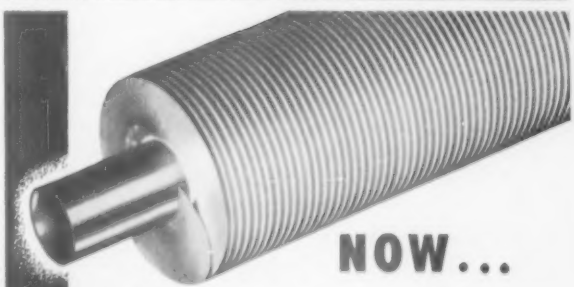
SOLE LICENSEE TO MANUFACTURE VACUUM TANKS UNDER U.S. PATENT NO. 2522077

EXPLOSION PROOF MOTORS



Continental ELECTRIC MOTORS

PLANTS:
17 Main St., Newark 5, N. J.
1240 Harrison Ave., Rockford, Ill.



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Even Less **Air Friction**

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Heating and Cooling Coils

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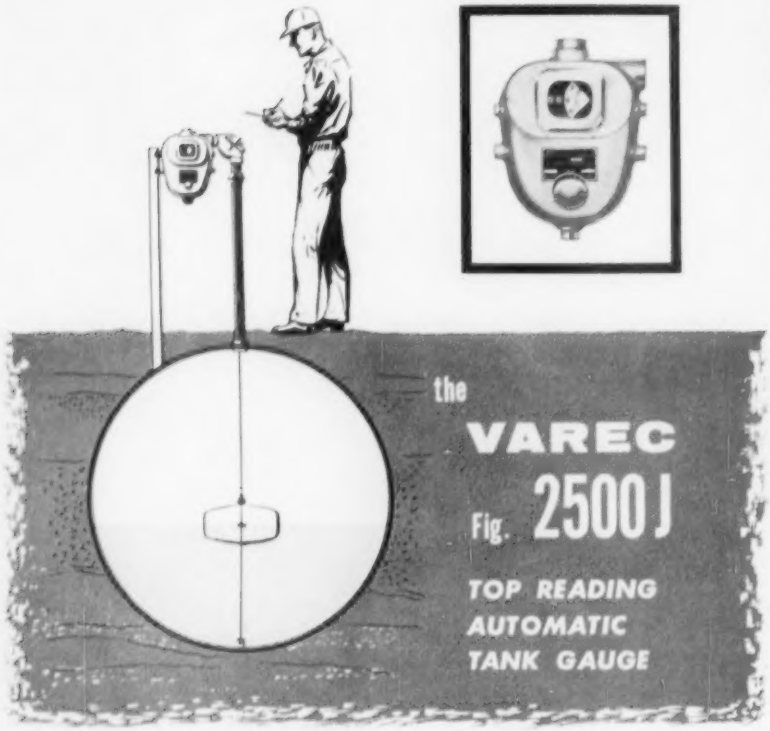
AEROFIN CORPORATION
SYRACUSE 1, N.Y.

for
UNDERGROUND Tanks



The Figure No. 2500 J is an application of the dependable, field-tested, Figure No. 2500 Series Gaugehead. A Figure No. 2500, mounted in this manner equals or possibly exceeds the accuracy of a conventional cone-roof installation. Large, easily read dial has gravity compensator. Float and Neg'ator motor actuated, no counterweights are required. Low pressure model illustrated — also manufactured with flanged connections for working pressures up to 300 p.s.i.g.

Can be used with Varec Remote Gauger Transmitters without disturbing original installation. Also installation may be made on tanks in service.

For additional details contact your nearest Varec representative or write direct.

"Varec"

VAPOR RECOVERY SYSTEMS COMPANY
2820 North Alameda Street
Compton 1, California
961-11
Cable address: VAREC COMPTON Calif. (U.S.A.) All Codes

mud. Also included are photographs and line drawings of typical units and their component parts. **For more information write or call: Dorr-Oliver, Inc., Barry Place, Stamford, Conn.**

●

Consolidated - Phillips Type 38 - 201 Process Refractometer for monitoring and control of petroleum and chemical processes is covered in Bulletin 1839. Printed in two colors and amply illustrated, this bulletin deals with construction details, operation information, application information, and actual installations. **For more information write or call: Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena 15, Calif.**

●

Tubend Welding Fittings lists complete specifications on a line of welding elbows, return bends, reducing and equal tees, caps, flanges, and concentric and eccentric reducers. **For more information write or call: B.K.L. Alloys, Ltd., Birmingham Factory Centre, Kings Norton, Birmingham 30, England.**

●

Gremco Expandable Van. This four-page brochure shows both interior and exterior views of a four-wheeled trailer-type van designed to be used as a field office, laboratory, or tool house. Sides of the van expand from 85 to 157 in. to furnish a large working area. The unit is equipped with exhaust fans, electrical switch panel, electrical outlets, fluorescent interior lights, and electric heaters. The van should be of particular interest to exploration crews, drilling contractors, and pipeline construction firms. **For more information write or call: Gremco, 3535 North Sylvania, Fort Worth, Tex.**

●

Automatic-Regulating Valves for Level or Pressure Control. Folio No. 4 briefly describes a number of control valves for liquid level and pressure regulation. Illustrated units include float and lever valves, pump generators, and pressure regulators. **For more information write or call: Schade Valve Manufacturing Co., 2527 North Bodine Street, Philadelphia 33, Pa.**

●

The Use of Gates Polyethylene Pipe for Natural Gas Transfer. Fact folder No. IH-1407 is an informative report on the use of polyethylene pipe in the field. The report includes charts on working pressure, pressure loss, and fuel-cost comparison. It includes useful formulas for ascertaining power requirements and cubic feet per hour of

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In football it was "Red" Grange—
For smooth, free plunger operation
under all kinds of pumping conditions it is

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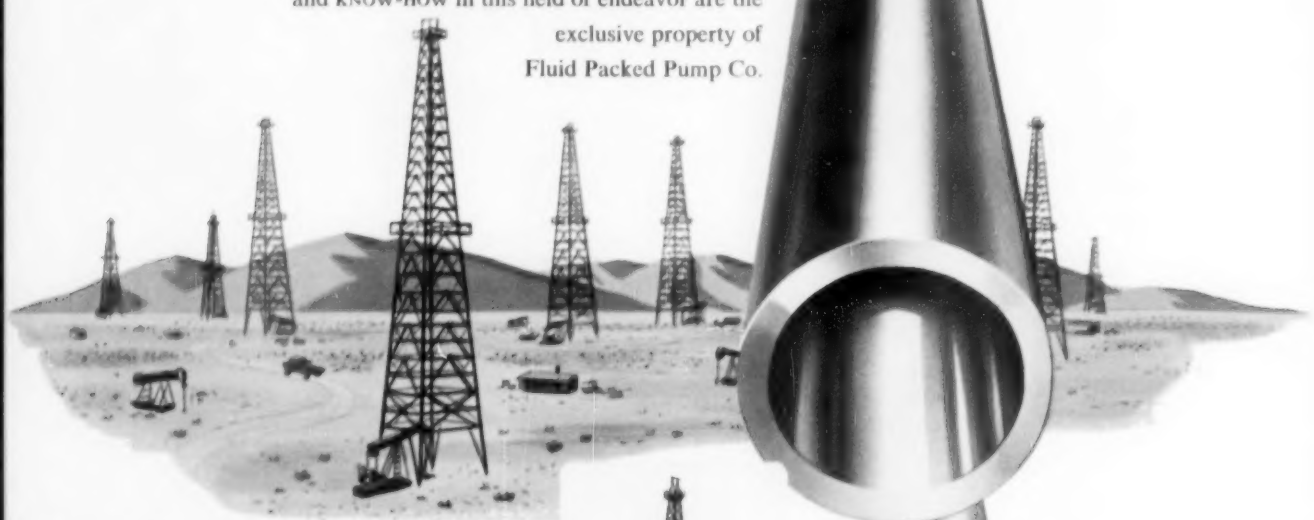
HARDENED AND HONED
ONE PIECE PUMP BARRELS

Their design and general construction can, has and will be copied, but thirty years of EXPERIENCE and KNOW-HOW in this field of endeavor are the exclusive property of Fluid Packed Pump Co.



FLUID PACKED PUMP COMPANY
Main Office and Plant, Los Nietos, Calif.

Distributed by the National Supply Co., Pittsburgh, Pennsylvania • Export: The National Supply Co., Export Division, 600 Fifth Ave., New York • Co-Distributors: Berry Supply Store, Beacon Supply Co., Industrial Supply Co.

oilmaster PUMPS FOREMOST IN THE INDUSTRY

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Reprints of the illustration of "Red" Grange without advertising sent on request

flow. **For more information write or call: Edwin J. Busch, Jr., The Gates Rubber Co., 1001 South Broadway, Denver, Colo.**

●

Package Unit Steam Generators. Bulletin PSG-2 shows steam generators in various stages of completion and installation of these units in refineries and gasoline plants. Center spread of the bulletin is devoted to plant facilities for manufacturing steam generators. Line drawings and charts of capacities, dimensions, and weights are all included. **For more information write or call: Henry Vogt Machine Co., Inc., P. O. Box 1918, Louisville 1, Ky.**

●

Blowout Preventer Closing Units and S. & S. Hydropneumatic Accumulators are described in a new 44-page, two-color illustrated catalog. Detailed information is given on each model in both lines, and photographs, cutaway views, and mechanical drawings are used to illustrate service instructions, parts descriptions, and performance specifications. Price lists and data pertinent to the selection, purchase, and application of standard or custom-made equipment are included. Featured also are: slush-pump pulse dampers, testing units, and rig-lubrication systems. **For more information write or call: Stewart & Stevenson Distributing Co., 1719 Preston Avenue, Houston, Tex.**

●

Corrosion Resistance of Glassed Steel. The corrosion resistance of glassed steel to five acid solutions, nitric, acetic, sulfuric, hydrochloric, and phosphoric, is described in a new bulletin. Information contained in the bulletin, based on recent tests made by the company's corrosion laboratory, is designed to provide the engineer with a working knowledge of this material construction. Factors affecting the resistivity of glassed steel are reviewed. The bulletin further reports how these factors apply specifically to the various acid solutions tested. **For more information write or call: The Pfaulder Co., 1000 West Avenue, Rochester, N. Y.**

●

Aanalysis of Gases and Liquids by Gas Chromatography. The new 12-page booklet 83 describes the Kromo-Tog, a new self-contained instrument for the analysis of gases and liquids by gas chromatography. Fully explained is the elution method of analysis for which the Kromo-Tog provides all of the basic instrumentation needed by the modern laboratory. **For more information write or call: Burrell Corp., 2223 Fifth Avenue, Pittsburgh 19, Pa.**

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the DRESSER way
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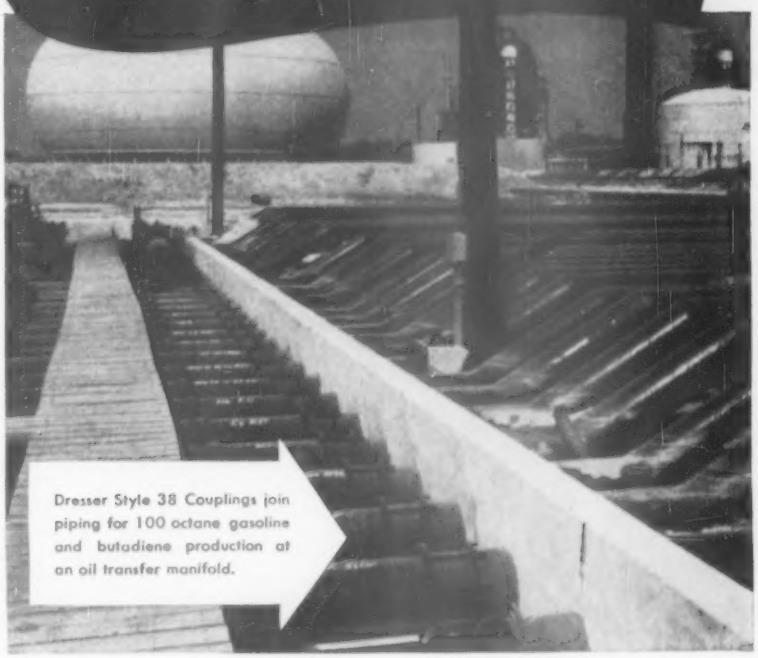

Dresser Style 38 Couplings join piping for 100 octane gasoline and butadiene production at an oil transfer manifold.

You'll find many piping applications in and around oil terminals and refineries where Dresser Couplings will simplify and speed up joining work. They're particularly advantageous for tank and equipment installations.

Dresser Couplings provide attractive features for refinery applications . . . they're easy and fast to install, bottle-tight and safe. The specially compounded rubber gasket permits up to 4° deflection at joints—yet with Dresser Couplings, these joints stay permanently tight.

AVAILABLE AT LEADING OILFIELD SUPPLY STORES

Style 38 Coupling | Style 40 Long Sleeve | Hydrepair* Asbestos Cement Pipe Clamp | Style 63 Expansion Joint | Style 39 Insulating Coupling

*HYDREPAIR is a trade-mark of Dresser Manufacturing Division

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Dresser Manufacturing Division, 49 Fisher Ave., Bradford, Pa. (One of the Dresser Industries).
Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Airport Blvd., S. San Francisco, Calif.

EQUIPMENT MEN . . . in the News

Robert Young Named N. Y. Manager of Peerless Pump

R. P. YOUNG

Robert P. Young has been named manager of the New York district office of Peerless Pump Division, Food Machinery & Chemical Corp. He succeeds F. W. McCann, resigned. Young joined Peerless Pump in 1948. Recently Young has been a Peerless sales engineer, with headquarters in Pittsburgh.

Tube-Kote Makes Edgar Area Sales Manager

L. C. EDGAR

Lynn C. Edgar has recently been appointed sales manager of Tube-Kote, Inc., Larry Heinen, president of the Houston plastics firm, has announced. Edgar will supervise the activities of all Tube-Kote sales engineers in a seven-state southwestern area and personally service Tube-Kote customers in the North Texas region.

Besides these duties, Edgar will direct the bimonthly technical meetings instituted this year for key personnel. These technical meetings provide for the interchange of practical experiences in solving corrosion and paraffin deposition problems for the oil industry.

Edgar has been a sales engineer with Tube-Kote for 7 years. Before joining Tube-Kote, he was with Humble Oil & Refining Co.'s Baytown Laboratory Testing Division.

Bovaird Opens New Store at Pawhuska

As a part of its expansion program, Bovaird Supply Co. opened a new store at Pawhuska, Okla., October 3, according to William J. (Bill) Bovaird, general manager of stores. J. C. Phillips will be store manager under F. J. Robbins, district manager at Oklahoma City. Phillips, who has been with Bovaird since 1950, has been servicing the territory out of Sapulpa as a salesman the past 2 years. He was formerly located at Seminole, Okla.

The Pawhuska store will serve the Osage and Burbank areas, southeastern Kansas, and northeastern Oklahoma territory.

Rockwell Names Morgan Regional Sales Manager

D. C. MORGAN

Donald C. Morgan, Chicago district sales manager of Rockwell Manufacturing Co.'s Meter and Valve Division, has been named central regional sales manager with offices at Pittsburgh. Morgan, who joined Rockwell in 1930 as a sales engineer in the Chicago office, replaces Carl C. Moore, whose retirement has been announced.

R. V. Burnette, gas sales supervisor for the central region, succeeds Morgan as Chicago district sales manager.

Moore, who also joined Rockwell in 1930, served as general manager of the old Meter Parts Co. of Columbus, Ohio, a former Rockwell subsidiary. In 1943 he was named Atlanta district sales manager, and later served in the same capacity at Columbus and Pittsburgh. He became Central regional manager in 1952.

Burnette joined Rockwell's sales staff in 1926 and was named gas-sales supervisor for the central region in 1949.

Benson-Lehner Data Cruiser Is Touring Oil Country

Oil companies throughout the nation will be visited within the next few months by the Benson-Lehner Corp.'s Data Cruiser, a mobile unit housing a complete data-handling system. The purpose of the visits will be to put the company's automatic machines directly into the hands of geophysical-engineering staffs and to demonstrate on the spot the ability of the new machines to unearth the information which is buried in scientific records. The Data Cruiser is a complete line of Benson-Lehner data-reduction machines.

Prairie to Manufacture Steel Pipe in Canada

Formation of Prairie Pipe Co., Ltd., of Regina, Sask., to manufacture steel pipe for the oil and gas industries was announced today by D. W. Darnell, chairman of the board of Fluor Corp., Ltd., Los Angeles, and president of the new firm.

Operating as an affiliate of Fluor Corp., the new company's plant will be located on a 110-acre site, already purchased, on the outskirts of Regina. The plant, scheduled to go into operation April 1, 1956, represents a total investment of more than $3,500,000. Construction will begin immediately and will involve about 100 men at the plant site.

J. E. Cunningham, former district engineer for Fluor in Houston, has been named vice president and general manager. Cunningham will be located at Regina. The capacity of the plant will be more than 100,000 tons a year.

H. C. Smith Names Holt District Sales Engineer

CLEVE HOLT

Appointment of Cleve Holt as district sales engineer for H. C. Smith Oil Tool Co. has been announced by Arthur S. Marshall, general sales manager. Holt will maintain headquarters in Houston and will service East Texas and Louisiana. He was for several years field engineer for Security Engineering Co. in Texas and Oklahoma.

Louisiana Bank Names Cashen Head of Petroleum

Robert F. Cashen has been appointed manager of the petroleum department of the First National Bank, Shreveport, La., President Walter B. Jacobs has announced.

An experienced petroleum engineer, Cashen spent 5 of his 7 years with Stanolind Oil & Gas Co. in engineering development and production in this area, working in such fields as Pine Island, Shongaloo-East Haynesville, Big Creek Delhi, and various other major explorations in southern Arkansas, Mississippi, and Alabama.

With his concentration during the past 2 years on valuation and reserve

compare your present fillup cost with Strata-Crete 6*

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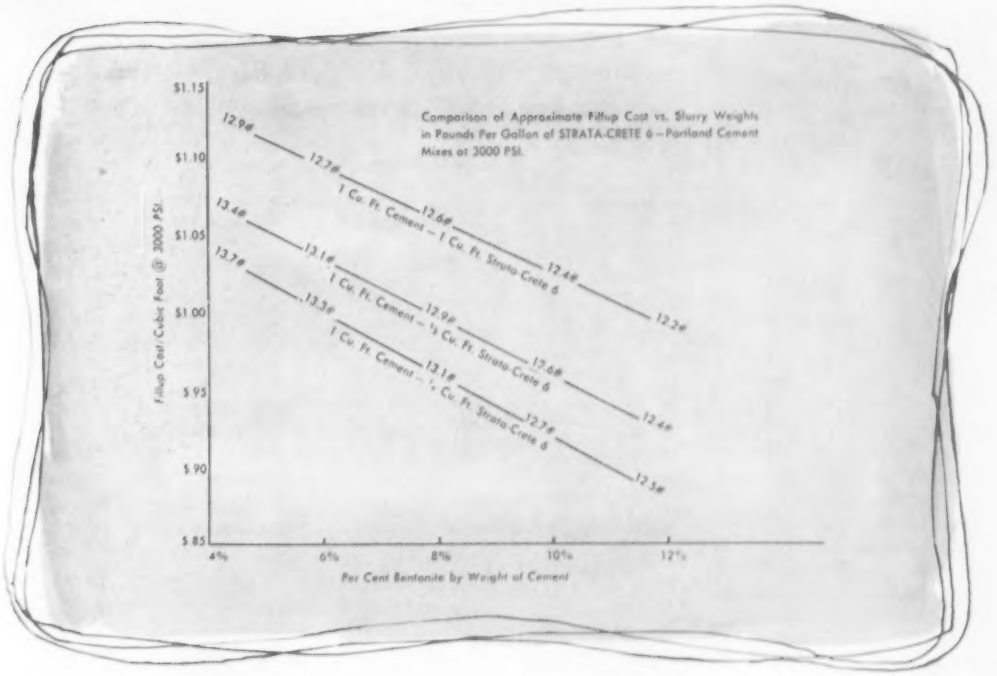
new perlite aggregate



plus these advantages:

Low Fillup Cost

The excellent bridging and lightweight properties of Strata-Crete 6 cement slurries reduce loss to thief formations, keep the slurry in the annulus. Therefore, *actual* cost to fill a given annulus is usually less than the cost when using other cement mixtures.

Easily Placed

Lightweight Strata-Crete 6 cement slurries are placed with normal pump pressures. The relatively low hydrostatic head reduces pressure on the formation and minimizes pressure parting of the formations. Its scouring action aids in removing wall cake and bridges formed by formation fragments. Therefore, a more uniform sheath of concrete is obtained, because channeling is minimized. The slurry is placed with very little contamination from muds and formation fluids.

Better, Cleaner Perforating

Early compressive strengths of recommended Strata-Crete 6 cements are high enough to prevent casing movement, low enough to allow maximum perforating penetration. Increased resiliency gives cleaner perforating, reduces shattering and fracturing, assures more accurate perforating into the producing zone. Even though recommended Strata-Crete 6 slurries have high resiliency, they also have low permeability.

Availability

Strata-Crete 6 can be obtained from your oil-well cementing service company.

Write today for complete technical information. Strata-Crete 6 Sales Representative in Corpus Christi, Houston, Odessa, Texas; Lafayette, La., and Norman, Okla.

Sales Representative in Rocky Mountain Area: Mud Control Laboratories, Inc.

In California: Macco Corporation.

* Refers to gallons of water required for each cubic foot of Strata-Crete 6.

GLC

GREAT LAKES CORPORATION

A Subsidiary of Great Lakes Carbon Corporation
1204 Prudential Building
Houston, Texas

work, Cashen will be an important asset to the petroleum department, Jacobs said. During this time, Cashen headquartered in Wichita, Kans., and was responsible for appraising Kansas and Oklahoma Panhandle properties for Stanolind.

BJ Extends Simultaneous Radiation Logging Service

BJ Service, Inc., is now offering simultaneous radiation logging services in the Pacific Coast division. This modern method of well logging (using the Perforating Guns Atlas Corp. method) has been successfully used by PGAC in the Mid-Continent and Gulf Coast areas and has been used with equal effectiveness by BJ Service, Inc., in their Rocky Mountain division.

Darling Appoints Lenzer Cincinnati Sales Engineer

Donald W. Lenzer, Cincinnati, Ohio, has been appointed sales engineer in the Cincinnati territory by Darling Valve & Manufacturing Co., Williamsport, Pa.

Lenzer, who has received the company's customary thorough factory training, will provide highly qualified sales-engineering service in the area consisting of southern Ohio, southern Indiana, West Virginia, and eastern Kentucky under the direct supervision of regional manager B. E. Engstrom of the company's Chicago district office.

Chemical Process Names O'Connell District Manager

Charles H. O'Connell has been appointed district manager at Pauls Valley, Okla., for the Chemical Process Co. He formerly was assistant district manager of the firm's Seminole, Okla., station. O'Connell joined Chemical Process in 1948.

Los Angeles Nomads Induct Five New Members

Five new members were inducted into the Los Angeles chapter of Nomads at the September dinner meeting. Flanked on their left by Harry Hester of McCullough Tool Co., ritual master, and on their right by Rex Collins of Hydril Co., deputy sergeant-at-arms, the new members are Ross McClintock, Shaffer Tool Works, associate member; Homer Hollingsworth, Johnston Testers, associate member; Dick McKey, the Petroleum Engineer, associate member; Walter B. Reinhold, Abegg & Reinhold, regular member; and James B. Wilcox, S. R. Bowen Co., regular member. The principal address was made by Jack Ballagh, Jet-Lube, Inc. His subject was Indonesia.

Macco Corp. Adds Van Loozen to Staff

C. F. Van Loozen recently joined Macco Corp., Paramount, Calif., in their refinery and chemical division sales.

Prior to joining Macco, Van Loozen was with Ideco division of Dresser Equipment Co. for 10 years in domestic and export sales and as California sales manager. Previous connections were with Lummus Co. and Oil Well Supply Co. as division engineer and manager of machinery sales.

Volpi Named Pfaudler District Representative

Pfaudler Co., Rochester, N. Y., announces the appointment of John S. Volpi as district sales representative serving Kansas, Oklahoma, Nebraska, Colorado and northwest Missouri.

Volpi joined Pfaudler's chemical-sales department in 1953. His office will be located at Mission, Kans.

HTL Names Dr. Jones As Chief Engineer

Dr. Hal J. Jones has been appointed chief engineer of Houston Technical Laboratories, petroleum-instrumentation subsidiary of Texas Instruments, Inc., HTL President R. W. Olson has announced. Jones currently is director of geophysical research in the TI research division in Dallas. This position will be taken over by Dr. John A. F. Gerrard, director of geophysical research at HTL.

Jones is the author of many geophysical articles and papers on seismic-exploration methods, applications of information theory, and the elasticity of rocks and minerals at high pressures and temperatures.

Jones has been heading the geophysical research at Texas Instruments for 3 years. Immediately prior to joining TI, he was research engineer and party chief of the geophysical-research group at Stanolind Oil & Gas Corp. and before that was associated with Engineering Research Associates and Shell Oil Co.

As chief engineer at Houston Technical Laboratories, Jones will be responsible for the design and development of all instruments and products.

Powerama Visitors Inspect Industrial Units

Recent visitors at General Motor's Powerama, inspecting prime movers for pumps, drilling rigs, and mobile equipment were: E. F. Bentley, sales manager, Detroit Diesel Division, General Motors Corp., Detroit; W. L. James, purchasing agent, Stanolind Oil & Gas Co., Tulsa; F. H. Rhees, vice president, Sinclair Oil & Gas Co., Tulsa; Arch F. Campbell, petroleum-industry sales, Detroit Diesel Division, General Motors Corp., Tulsa; and R. B. Warren, Jr., president, Warren-Bradshaw Exploration Co., Tulsa.

A. O. Smith Co. Announces Sales Personnel Changes

William C. Powell has been named district sales manager for the Tubular and Process Equipment Division of A. O. Smith Corp., and Joseph Coffman has joined the sales force of the Process Equipment Division.

Powell formerly was sales manager for the company's Tubular Products Division.

Coffman will work out of the Chicago regional sales office, according to Warren Hendricksen, division general sales manager.

Export Representative Is Named by Fluid Packed Pump

R. C. THOMPSON

The appointment of R. C. (Bob) Thompson as export representative has been announced by Sidney Shuman, executive vice president of Fluid Packed Pump Co. He will work with their distributor, National Supply Co., to service Oilmaster products throughout Latin America. He will make his headquarters at Maracaibo, Venezuela.

Enterprise Names Sanger To District Manager Post

Miles B. Sanger has been appointed Huntington, W. Va., district manager of Enterprise Engine & Machinery Co., San Francisco, a subsidiary of General Metals Corp., it has been announced by Arthur W. Ostrander, general sales manager of Enterprise.

Sanger has been associated with Superior Engine Division of National Supply Co. for the past 14 years.

Oilwell Shifts Dendy To Shreveport Post

James C. Dendy, assistant district engineer, machinery and equipment sales and service, of U. S. Steel's Oil Well Supply Division, has been transferred from Greggton, Tex., to Shreveport, La. The announcement was made by William Miskimins, Central Midwest area manager of the division.

Dendy was employed in 1953 as an engineer trainee at Hobbs, N. M. The following year he was transferred to Greggton. In June 1955, he was appointed assistant district engineer, machinery and equipment sales and service, at Greggton. He had been located there until his present transfer.

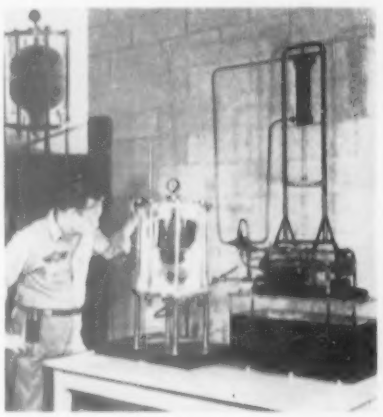
Mackie Appointed Rhodia Pacific Representative

Rhodia, Inc., New York, has announced the appointment of W. C. Mackie as technical sales representative on the Pacific Coast for its aromatic chemicals and Alamask industrial reodorants. He has established temporary headquarters in Pasadena, Calif.

Mackie comes to Rhodia with considerable experience, having been with the original Albert Albeck, Inc., and with Polak & Schwarz, Inc., since 1949, where he served in purchasing, laboratory supervision, and as sales manager for 11 western states.

Bladder Accumulators To Be Demonstrated

Oil-industry people attending trade meetings in Lafayette, La., and Houston this fall will see a completely visual demonstrator unit showing how



hydropneumatic-bladder accumulators work when applied to oil-field blowout-preventer closing units or to slush pumps.

The bladder-type accumulators are also adapted to surge or pulse dampers. The exhibit pictured is sponsored by Greer Hydraulics, Inc., and Stewart & Stevenson Distributing Co. Greer pioneered, and designs and produces hydropneumatic accumulators incorporating a rubber bladder component (inset). Stewart & Stevenson has adapted the device to the Koomey blowout preventers and also distributes the Greer accumulators for applications on oilwell slush pumps.

The exhibit was shown at the annual meeting of the American Association of Oilwell Drilling Contractors at Houston and will be shown at the Louisiana Gulf Coast Oil Exposition at Lafayette.

Ingalls Appoints Goodere District Sales Engineer

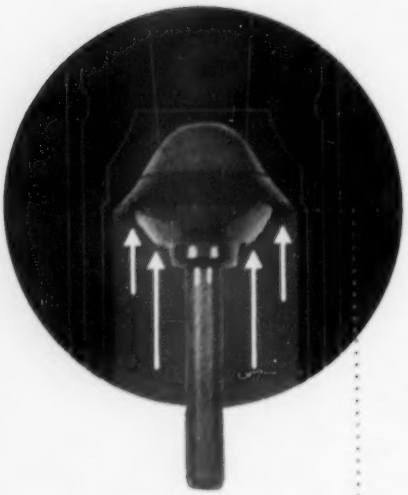
William E. Goodere, according to a recent announcement, has been appointed district sales engineer for Ingalls Iron Works Co. and its subsidiaries, Ingalls Shipbuilding Corp., Ingalls Steel Construction Co., and Birmingham Tank Co. He will occupy offices in the Melrose Building, Houston.

For the past 2 years Goodere has been a construction representative with the Todd Shipyards Corp., Houston. Prior to that time he was sales manager of the Farnsworth and Chambers Co. and the Consolidated Western Constructors, Houston.

He was district manager of the New York office of the Ingalls Iron Works Co. in 1930.

Westinghouse Air Brake Holds Advertising Meeting

Advertising managers of Westinghouse Air Brake Co. of Pittsburgh, Pa., and its divisions and subsidiaries, met recently at Peoria, Ill., for a roundtable on advertising and promotional plans for 1956. In the picture are: R. T. Shafer, advertising manager, Westinghouse Air Brake Co., Pittsburgh; Glenn W. Graf, advertising manager, Le Roi Co., Milwaukee, Wis.; R. H. Koehler, director of advertising and publicity for Westinghouse Air Brake Co., Pittsburgh; A. B. Ledwith, advertising manager, Union Switch & Signal Division, Swissvale, Pa.; P. E. Lagatolla, advertising manager, Industrial Products Division, Wilmerding, Pa.; H. J. Godschalk, advertising manager, George E. Failing Co., Enid, Okla.; Lloyd A. Rager, advertising manager, LeTourneau-Westinghouse Co., Peoria, Ill.



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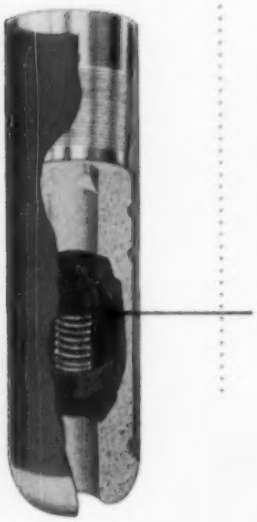
Dependable
Deephole
Cementing

HALLIBURTON'S

SUPER SEAL
FLOATING EQUIPMENT



Most dependable cementing in super-deep holes depends on a *super seal*. These wells need the greater protection against high temperatures and pressures provided by Halliburton's Super Seal floating equipment.

Operating under deephole conditions that cause ordinary valves to fail, the Super Seal conical valve is superior. This valve has a wide contact surface that distributes pressure over a larger area than ordinary ball valves and prevents damaging wear. A special lip ring of oil resistant rubber is used to give more positive and instantaneous shut-off. Super Seal also has the advantages of faster drillability, unexcelled flow area and improved guide design.

For the best cement job possible on your next deep well—use Halliburton's dependable Super Seal floating equipment. Call your local or district office of the Halliburton Oil Well Cementing Company.

COMPLETE DATA SENT ON REQUEST

Get this valuable information for your Halliburton Service File.

HALLIBURTON **CEMENTING EQUIPMENT**

250 SERVICE CENTERS — JUST MINUTES AWAY FROM ANY RIG

No. 2 For the Cambridge Arch?

Nebraska's wildest 1955 wildcat could open second producing area on structure

by John C. McCaslin

THE exploratory year of 1955 will go down in industry annals as one of far-removed discoveries. The oil search has carried wildcatters into every nook of exploration country. Discoveries have popped up in remote places like the Val Verde basin of the distant Big Bend country of Texas, the Northwest Territories of Canada, in dry Idaho, and in other relatively untested areas.

Now it's southwestern Nebraska that is striving to get into the last chapters of the year's exploratory history.

There is further evidence . . . Nebraska's wildest wildcat for 1955 is the Jones, Shelburne & Farmer 1 Fritz, 8 miles west of McCook in Hitchcock County. This key test could open the second producing area on the extensive Cambridge arch.

The 1 Fritz swabbed 5-7 bbl. of oil hourly after acidization from perforations at 3,881-86 ft. in the Lansing-Kansas City (Pennsylvanian). It flowed 1½ bbl. of oil per hour, natural. The operator was swabbing at last report.

Closest oil production to the indicated strike is Norton pool in Norton County, Kansas, 60 miles southeast. Nearest Nebraska production is about 100 miles to the northwest in Deuel County in the Denver-Julesburg basin.

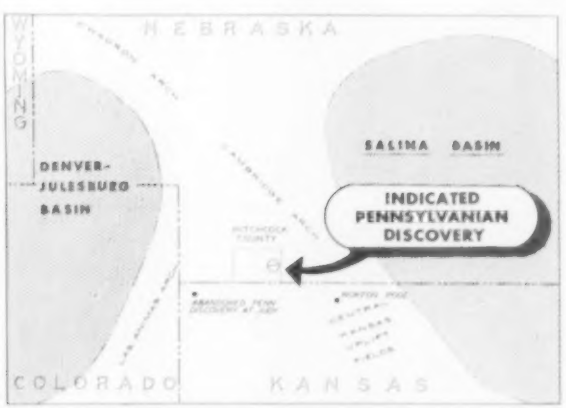
Norton pool is the only and first major oil-producing area on the Cambridge arch. It is located at the southeast end of the large anticlinal feature. More than 100 wells are producing from the Arbuckle lime and Reagan sand of Cambro-Ordovician and Cambrian age, respectively. The discovery of Norton pool cemented previous western Kansas wildcat data that indicated the possibility of stratigraphic entrapment of oil on the Cambridge arch similar to that of the Central Kansas uplift.

Of productive possibilities . . . The search for oil in this wide-open wildcat country has been under way for many years, and every test drilled has been watched with vigil. The score for Nebraska oil hunters has been zero. Exploratory interest has been evident in recent months from the Chadron arch southeastward to southwestern Nebraska. Jones, Shelburne & Farmer have been quite active recently in Hayes, Red Willow, Phelps, and Buffalo counties, but this is the first drilling for the Hitchcock County area.

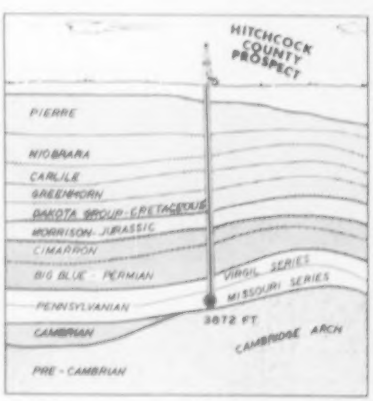
The prolific Cambro-Ordovician Arbuckle formation of Kansas and Oklahoma fame wedges out against the Cambridge arch just north of the Kansas line. In this southwest section of Nebraska rocks of Pennsylvanian age lie directly on the pre-Cambrian granite. For many years it has been thought oil would be found in or near this unconformity. About 5 years ago a small Pennsylvanian oil pool was opened in Cheyenne County, Kansas, southwest of the Hitchcock County prospect, but the second well was dry and the field was abandoned.

There are several other Pennsylvanian pools in western Kansas, and Nebraska wells have reported good Pennsylvanian shows in past years, but the rocks have shown little porosity and permeability.

On the Cambridge arch . . . This arch is a large anticlinal feature lying on the same structural trend as the Central Kansas uplift. There is a structural saddle separating the two regional features. The arch is a relative to the broad, southeastward-plunging uparch of pre-Cambrian rocks known as the Chadron arch, running northwestward across Central Nebraska to the Black Hills of South Dakota. Location of the Hitchcock County well is near the Cambrian pinchout against the Cambridge arch . . . off the north end of Las Animas arch and east of Denver-Julesburg basin.



Regional setting of Hitchcock County, Nebraska, in relation to the Denver-Julesburg and Salina basins, the Cambridge arch and Central Kansas uplift.



Generalized cross-section of the area near the Kansas-Nebraska line in Hitchcock County, Nebraska.

BP PROBES DEEP AND FAR

FROM A PALACE on the shores of the Persian Gulf, Shaikh Shakhbut ibn Sultan's rule extends over the territories of Abu Dhabi, both the land and the waters overlying its continental shelf. Beneath these waters—perhaps—lies oil.

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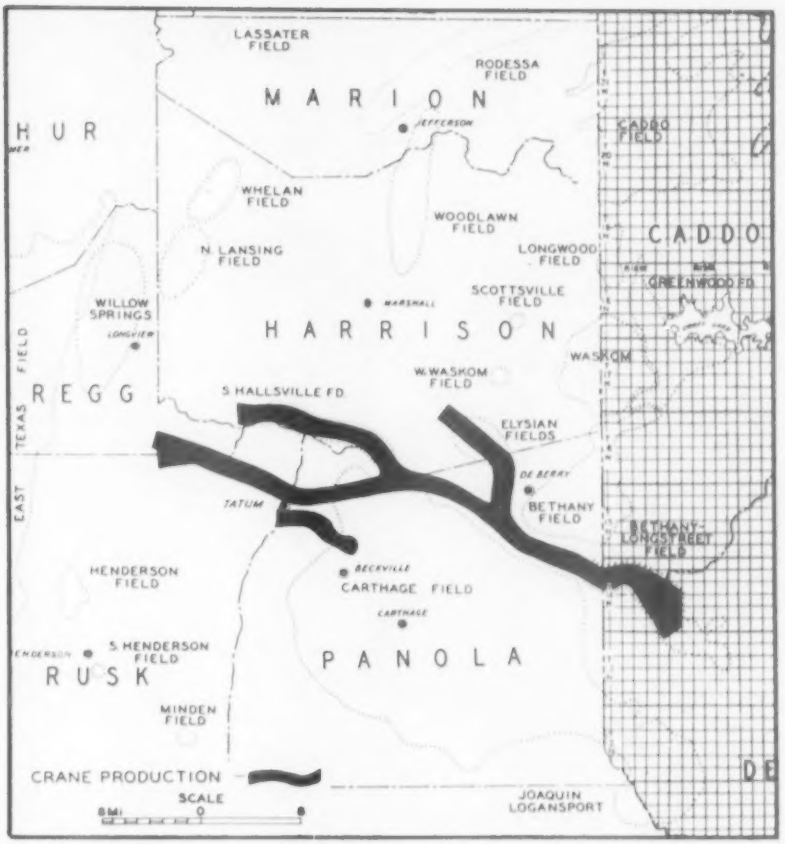


CRANE-PETTET trend is now about 43 miles long and averages 1½ to 2 miles in width. It is an apparently structureless porosity belt that is anomalous in nature. Fig. 1.

Crane-Pettet Trend Forces Reappraisal of Ark-La-Tex

by Michael W. Beckman
Consulting Geologist

DURING the last few years, a popular dogma espoused by certain oil-company executives asserted that the reserves of hydrocarbons yet to be discovered and developed in the Ark-La-Tex area will not be great enough to justify the expense of maintaining more than a skeleton staff of exploration personnel there.

While these executives were bemoaning this gloomy conclusion, several of the smaller independent oil operators and drilling contractors were developing with dispatch and great success a major gas-condensate reserve, the so-called "Crane" Pettet porosity trend. The development now stretches from the South Hallsville area of Harrison County, Texas, to the Longstreet area of DeSoto Parish, Louisiana—a distance of more than 43 miles.

How It Began

Pettet production in the Ark-La-Tex area is not new. In October of 1936, Producers Oil & Gas Co. 1 Mrs. G. F. Pettet, located in Sligo field of Bossier Parish, Louisiana, was completed as a gas-condensate well. It produced from a porous oolitic and pseudo-oolitic limestone within a sequence of dark gray marine shales and dense crystalline gray and brown limestone.

Not only did the section penetrated in this well serve as the type locality for the Sligo formation, but from it was also derived the more colloquial term "Pettet." This term refers in general, to any porosity development found within the confines of the Sligo formation.

Pettet reserves grow . . . Following this initial production from the Pettet, the Ark-La-Tex area blossomed forth with many new Pettet oil and gas discoveries. Among them were Carthage, Bethany, Woodlawn, and Trawick fields in East Texas, Shreveport and Haynesville fields in Louisiana, and North Haynesville and Horsehead fields of South Arkansas. The vast Carthage field alone boasts a proved recoverable from the Pettet of 4,500,000 M.M.c.f. and 26,000,000 bbl. of condensate.

That the areal distribution of a particular Pettet porosity may have considerable economic significance has long been recognized by geologists working in the Ark-La-Tex area. It has been general practice to differentiate and label Pettet porosities by means of a letter of the alphabet or by use of the name of the discovery well.

Early in 1952, W. M. Plaster, an independent Shreveport geologist, recognized that a certain Pettet zone found 180 ft. below the top of the Sligo formation that was producing in the Hollandsworth 1 Crane well in the Beckville area of northwestern Panola County, Texas, was the correlative equivalent of a Pettet zone producing in the Union Producing Co. 1 Lewis in Bethany field of northeastern Panola County.*

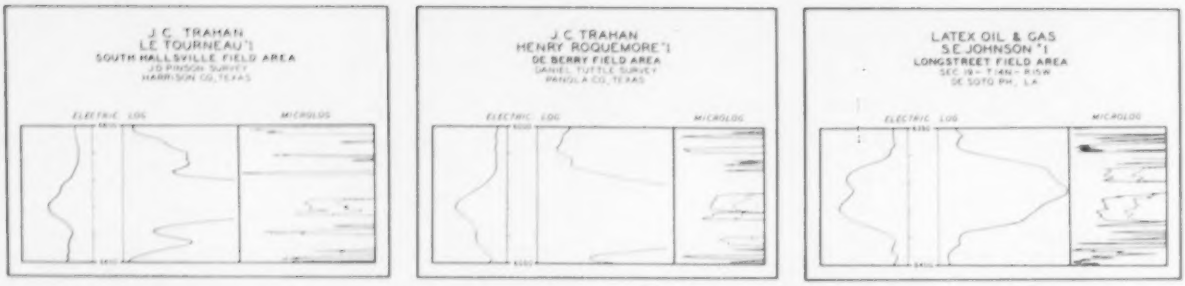
Although the zone in question is not developed in any of the many wells drilled in Carthage or Bethany fields proper, several dry holes drilled between the Beckville and Bethany areas had encountered some slight indication of limestone and/or porosity development in the critical interval.

From this, and because the Union well had suffered no appreciable pressure drops after 6 years of production, Plaster reached a conclusion. He believed that this particular Pettet member occurred as a relatively narrow band and constituted a single common reservoir linking together the Bethany and Beckville areas of Panola County.

A theory proved . . . To test this theory, a wildcat test, the Imperial 1 Johnson, was deliberately located within the limits of Plaster's projected porosity trend. Theory became fact when the Imperial well was completed in October 1951 as a rich gas-condensate producer from the Pettet objective. From this significant date, drilling operations for Crane zone production slowly gained momentum until boom proportions were reached in 1953 and 1954.

A valuable lesson can be learned

*Even though the name "Lewis" has priority over "Crane", general usage by the oil men makes "Crane" the preferable term.



REMARKABLE SIMILARITY of the Crane interval throughout its extent is revealed by these log sections from representative wel's at its western, middle, and eastern reaches. Fig. 2.

from the history of this period. Because much of the acreage later proved to be productive was located on or near a synclinal axis separating the Carthage and Bethany domes, its productive potentialities were considered nil by the usual standards of anticlinal accumulation. And for the most part this acreage was either unleased or available for farmout on very nominal terms.

A few company geologists either grasped the full implication of the Imperial 1 Johnson well, or were enlightened by Plaster. It is now painfully easy to picture their frustration in their attempts to sell management on the concept of economically attractive production from a synclinal area. Probably because of this reluctance on the part of the major companies to capitalize on the somewhat unique concept of the Crane trend, many of the 134 Crane wells drilled in Texas and the 14 Crane wells completed in Louisiana have been operated by independents.

And How It Grew

The geographical distribution of the Crane producing areas is shown on Fig. 1. The impressiveness as to size is readily apparent because fingers of Crane porosity have been found productive in parts of Gregg, Harrison, Rusk, and Panola counties in Texas, and Caddo and DeSoto parishes in Louisiana. With the exception of the southernmost trend in Panola County, all Crane prisms are probably interconnected.

Structure plays no apparent role in the development of porosity in the Crane. From a high point reached in the Bethany area, the beds enclosing the Crane slope downward both to the east and the west. And although the proved relief exceeds 1,000 ft., no indication of edge water has yet been found. All of the ends of the various fingers of porosity are open. In fact, at the eastern end in the Longstreet area, the Crane porosity trend has widened into a producing area 4 miles wide as compared to an average width of 1½ to 2 miles.

Crane wells are unusually rich in condensate, with yields ranging from 25 bbl. per M.M.c.f. in the Tatum area to slightly over 100 bbl. per M.M.c.f. in the Longstreet and South Hallsville areas. The cost of drilling and completing a Crane well will not exceed $80,000.

Fig. 2 shows the remarkable similarity of the Crane interval throughout its extent. The center log is from one of the better wells in the Longstreet area of DeSoto Parish, Louisiana, and the others depict development in the Bethany-Deberry area of Panola County and the South Hallsville area of Harrison County, Texas. The average net effective thickness of porosity throughout the area ranges from 6 to 10 ft. and a maximum thickness of 21 ft. has been encountered at Longstreet.

Crane wells are drilled on 640-acre units. By multiplying this figure by the 134 wells presently completed in Texas and Louisiana, a total of 85,760 productive acres (or approximately 134 sq. miles) is obtained. In terms of dollar value, reservoir engineers calculate the average Crane well to be worth between 1 and 2 million dollars. If an average value of 1.5 million is multiplied by 134 wells, a product approaching one-quarter of a billion dollars will result.

New methods necessary . . . From any approach—size, depth or economic value—the Crane trend constitutes first-class, highly profitable production which belies the opinion that the Ark-La-Tex area is washed up as an oil and gas-producing province. Successful exploitation of this Pettet porosity necessitated new and unique methods of mapping on the part of the subsurface geologist. Because the usual geophysical techniques were useless in the face of this challenge, every operator, both large and small, started even in the race for productive Crane acreage. The successful operator in this race was the one who acted promptly and implicitly on the advice of the subsurface geologist.

The Big Question

The big question remains: is the type of stratigraphic accumulation typified by the Crane trend a unique situation in the Ark-La-Tex area or will other highly profitable porosity trends be established there? The success of future exploration rests not only upon the shoulders of the subsurface geologist but depends also upon the willingness of the operator to act upon a somewhat vague idea that can only be confirmed by the drill.

Because the independents were quick to grasp and exploit the concept of this type of stratigraphic trap, the smaller operators reaped most of the rich reward given up by Crane production. Whether or not the larger companies remain blind to these happenings, the Ark-La-Tex is no longer the old model pictured by the gloomy prognosticators of a few years ago. The Crane zone has given the Ark-La-Tex a new look.

ABOUT THE AUTHOR

Michael W. Beckman graduated with a B.A. from University of North Dakota in 1939. He received his M.S. from Texas A.&M. College in 1941. He was a geologist with the following companies: Continental Oil Co., 1941 to 1945; Skelly Oil Co., 1945 to 1952; and the Mississippi River Fuel Corp. from 1952 to 1955. He is now a consulting geologist and independent operator.

EDITOR'S NOTE: For several years, since the first discovery of production from rocks of this age, inconsistency has reigned with regard to the spelling of "Pettet." Louisiana geologists commonly employed the "et" ending, while East Texans clung to "Pettit."

Investigation by the author of this article, which included examination of the tombstone of the owner of the farm for whom the beds were originally named, indicates "Pettet" as the correct nomenclature. Also, recent publications by the Bureau of Economic Geology of The University of Texas have employed the "et" spelling in preference to the "it" ending.

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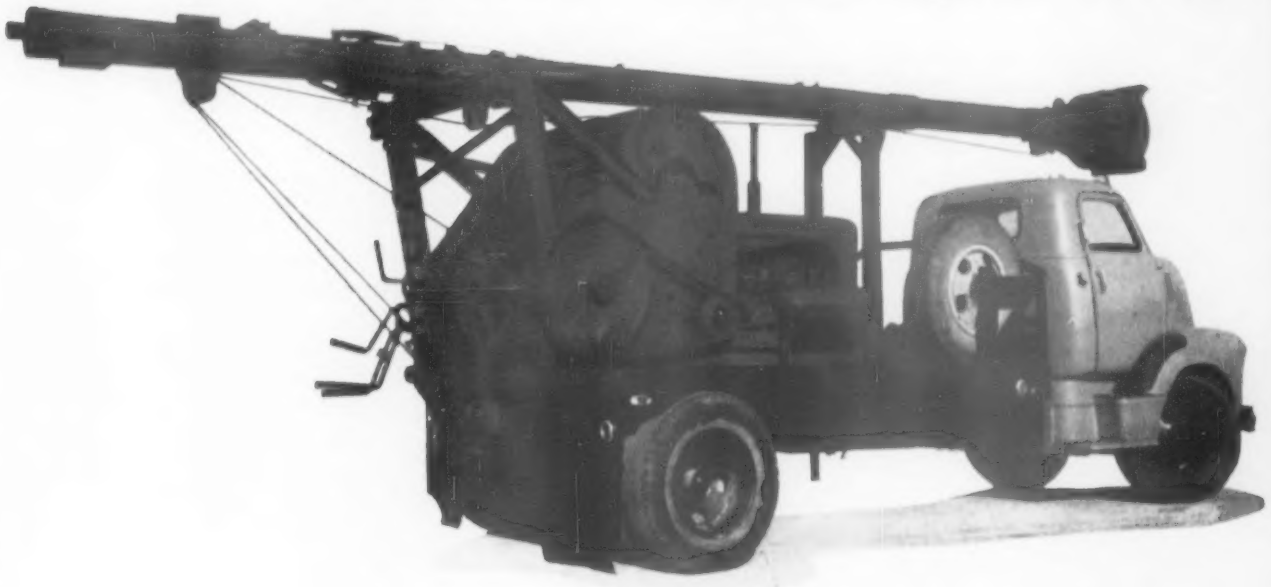

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EXPLORATION HIGHLIGHTS

North Texas Success Ratio Up For First Three Quarters

THE count of active rotary rigs last week in North and West Central Texas, Railroad Commission Districts 9 and 7-B, was down slightly, to a total of 245. But exploration work has held steady over the first 9 months of the year, and discoveries have been higher than usual.

Texas Railroad Commission records show District 7-B has gained a total of 99 oil discoveries in the three-quarter period of 1955. By counties, these were: Taylor 23, Nolan and Fisher 14 each, Stonewall and Coleman 13 each, and Jones County 12.

In Nolan and Fisher counties, several strikes have had heavy flowing potentials. In southern Fisher County, the opening of Sweetwater field set off a good drilling campaign early in the year. Sinclair Oil & Gas Co. 1 McIntyre opened the field with a daily potential of 1,272 bbl. of 41° oil through ½-in. choke, from Canyon sand pay at 5,212-51 ft.

Last week, G. E. Kadane & Sons 1 John Perry, 2 miles southeast of the town of Gannon and 3 miles west of Sweetwater field, opened a new field with a flow of 126 bbl. of oil in 15 hours through 18/64-in. choke. Pay was from 5,256-76 ft.

Week's developments also saw a prolific well completed in the new Ocho Juan field, 10 miles west of Rotan. Sun Oil Co. 1 Criswell flowed 1,875.5 bbl. of oil a day from Strawn pay at 6,000-20 and 6,034-52 ft. Gas-oil ratio was 611:1.

The same well also completed from Canyon pay at 5,836-62 and 5,874-86 ft. for 147 bbl. of oil a day through ¼-in. choke.

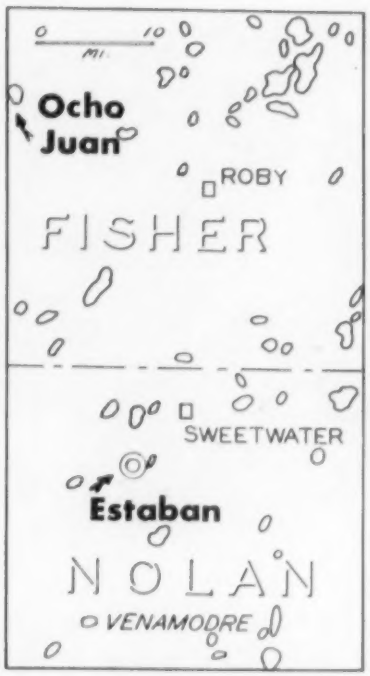
Nolan County . . . Estaban field, southeast of Roscoe in Nolan County, last week gained its second Strawn producer and an offset to the field's Ellenburger discovery.

Rex R. Moore 2 Tatum rated a daily potential of 1,448 bbl. of 45° oil, with gas-oil ratio of 1,280:1. This was based on a 3-hour gage of 186 bbl. through 36/64-in. choke, from perforations in the Strawn at 6,304-91 ft.

Estaban-Ellenburger field was opened by C. L. Norsworthy, Jr., 1 Howard, in 66-22-T&P Survey, 5 miles southwest of Sweetwater. Potential was 157 bbl. of oil a day from open hole at 6,660-88 ft.

New work at Estaban includes an Ellenburger test by Norsworthy as the 1-B Howard. Location is an east offset to the field discovery and projected depth is 7,200 ft.

Grayson County . . . This county is still at the top in number of operations in North Texas, but the count of active rotary rigs had dropped from a steady 60-75 to 45 last week. Several fields have been explored for new pay zones.



Ocho Juan field, northwestern Fisher County, is a new development, with high potentials from two separate pays. Estaban-Ellenburger field, northern Nolan County, received its second well in the Strawn.

Final gage was announced for R. P. Karll 1 O'Hanlon, wildcat 1 mile northwest of Sherman. Potential was 30 bbl. of 39° oil a day through 12/64-in. choke. Total depth was 9,000 ft., with top of Davis sand pay at 8,660 ft.

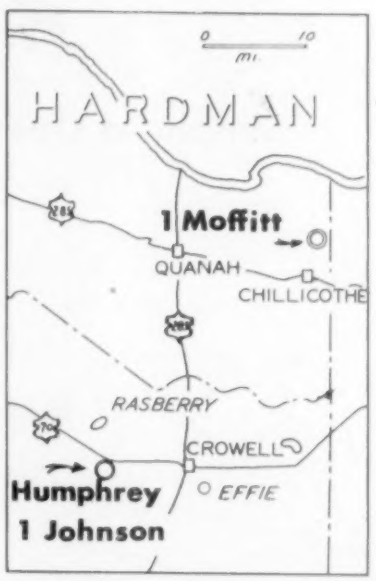
New Grayson County exploration last week included an amended application for a 9,000-ft. test 5 miles northeast of Sadler. The well is to be drilled by W. D. McBee, as 1 E. E. Sanders. Location is in the E. Tucker Survey.

Star Oil Co., Inc., will drill 1 Annie Miller as a 10,000-ft. test in northern Grayson County, 2 miles east of Southmayd. Location is on a 307-acre lease in G. M. Dial Survey, A-365.

New Activity in Foard And Hardeman Counties

Foard County's scanty production has been bolstered by three wells in the new Rasberry (Caddo, 6,000 ft.) field, 10 miles west of the town of Crowell. Lucerne Corp., Dallas, which has drilled all wells, completed its 2 Johnson for 146 bbl. of 38° oil a day through 18/64-in. choke, from pay at 6,112-72 ft. Gas-oil ratio was 426:1. The firm's discovery, 1 Maude Rasberry, found pay at 6,120 ft. and flowed 143 bbl. a day.

New prospecting for Foard County included two deep tests by Thomas D. Humphrey & Sons of Dallas. No. 1 Ribble is located 2½ miles northwest of Crowell in 503-A-H&TC Survey, and will be drilled to 7,500 ft. No. 1 Beulah Patton, projected to 7,500 ft.,



Foard County's Rasberry field now has three wells; Thomas D. Humphrey 1 Johnson is a deep wildcat. Hardeman test, Leonard 1 Moffitt, reported good oil shows on one drill-stem test.

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is 15 miles northwest of Crowell in 22-A-T&NO Survey.

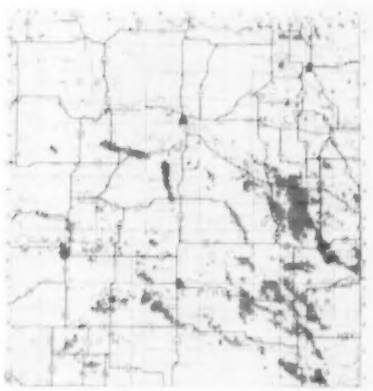
Thomas D. Humphrey's current operation is 1 Johnson, wildcat 8 miles west of Crowell, which was drilling below 6,200 ft.

Hardeman test . . . O. P. Leonard 1 Moffitt, Section 34, Block 10, H&TC Survey, reported good oil shows on test at 6,430-41 ft., but mud only on test at 6,756-80 ft. Bottom-hole pressure on the latter interval was 1,640 psi. A 30-minute test from 6,987-7,000 ft. returned 65 ft. of drilling mud. Location is approximately 5 miles north of Chillicothe.

MID-CONTINENT

Oklahoma Oil Industry Road Atlas Is Now Available

Research Oil Reports, 307 North Broadway, Oklahoma City, has available a new Oklahoma Petroleum Industry Road Atlas. This atlas is designed to conform to the industry's requirements.



Section of Oil Industry Road Atlas showing portion of southwest and south-central Oklahoma.

This easy-to-carry atlas is clearly defined by section, township, and range. Principal highways are shown in red and identified by markers. Oil and gas fields are shown in colors. Principal towns and cities are located. The atlas' linen cover surface can be cleaned with eraser. The state is divided into nine sheets, each sheet legal size.

OKLAHOMA

Further Bradley Expansion Noted in McClain County

The East Bradley district in McClain County has been further expanded at Cities Service Oil Co. 1 Brundgardt, C SE NW 30-5n-4w. The well flowed 105 bbl. of oil in 6 hours on ¼-in. choke or at a daily rate of 420 bbl.

Perforations in the Bromide sand were at 11,480-11,610 ft. Gravity is 44°. Gas-oil ratio is 1,418:1.

Bois D'Arc Extension Well for West Short Junction

A 1½-mile extension well in the West Short Junction pool area of Cleveland County was reported last week at Fred Morgan et al 1 Shroyer, C NW NW 13-10n-4w.

The extension discovery flowed 2,000-3,000 M.c.f. of gas per day on ⅛-in. choke from perforations in the Bois d'Arc lime at 7,799-7,819 ft.

Deepening Under Way at New Garvin County Strike

Superior Oil Co. tested the Gibson sand at 6,535-88 ft. at the Bromide sand discovery northwest of Maysville in Garvin County. The well flowed gas at the rate of 475 M.c.f. per day.

Previously the well flowed oil at the rate of 24 bbl. hourly from Bromide sand perforations at 7,323-75 ft. Location is in the SE NE NE 7-4n-2w.

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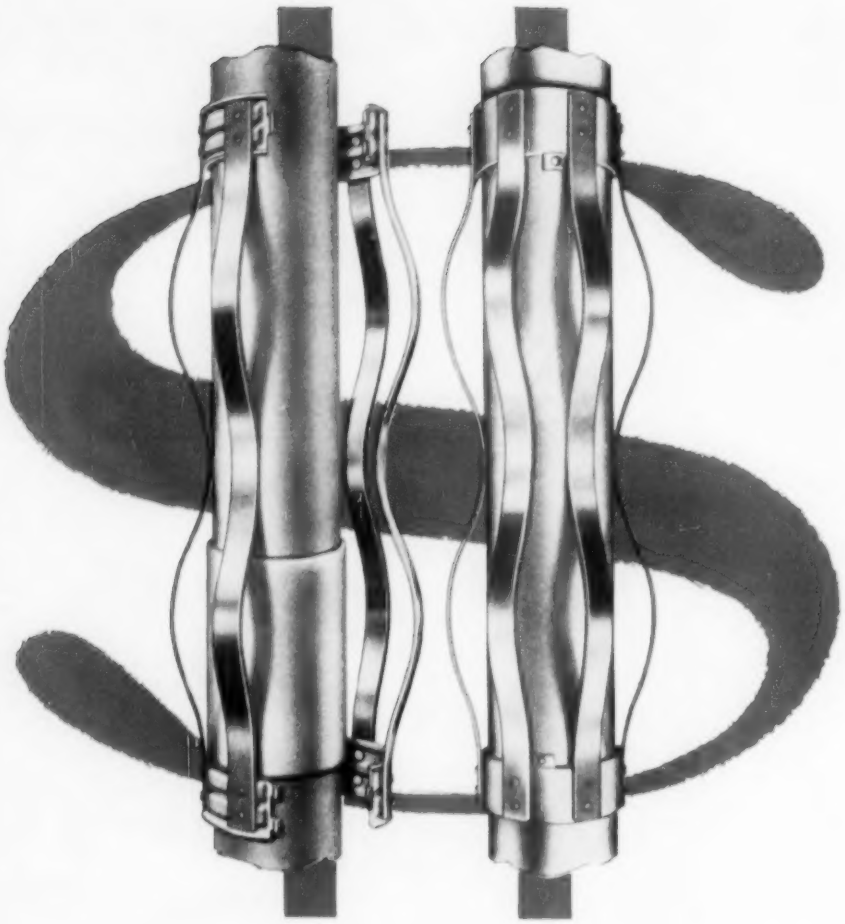

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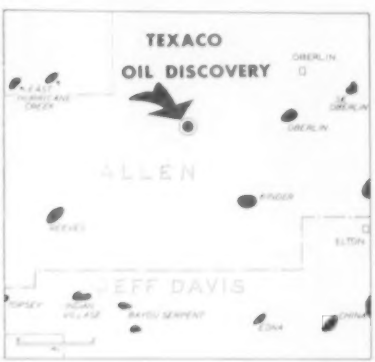
Oil Production Uncovered In Allen Parish Discovery

Opening of a new field, located 8 miles southwest of Oberlin, in southern Allen Parish, is virtually assured by results of initial tests in its indicated discovery well.

This well, drilled by The Texas Co., flowed 99 bbl. of clean oil per day on a test through ⅜-in. choke. Flow was under pressure of 490 psi., and was with gas-oil ratio of 328 cu. ft. per barrel. Gravity of the oil is 25.4°.

Production is from a casing-perforated interval at 5,890-92 ft. Hole was drilled to 10,000 ft.

Location is on Texaco's Rice Land Lumber Co. lease in 32-5s-5w. It is on the Harmony prospect, about 5 miles northwest of Kinder field and about 10 miles east of Clear Creek field, two of South Louisiana's most active fields.



Portion of southern Allen Parish showing location of The Texas Co.'s new oil discovery well in the Harmony area.

Beauregard Wildcat Tests Gas in New-Field Opening

Testing is under way at another prospective discovery well in southern Beauregard Parish, about 3½ miles northwest of DeQuincy, Calcasieu Parish.

Operators, Tennessee Gas Transmission Corp., General Crude Oil Co., and Harry Hurt, of Houston, have perforated casing in a 3-ft. interval at 4,714-17 ft. Initial test got a gas flow with pressure of 1,580 psi. No estimate of volume was reported.

The well, 1 Lutcher-Moore, in 9-7s-11w, originally was drilled to 6,907 ft. It is about 2 miles south of Oretta field, and about 4 miles from the old DeQuincy field.

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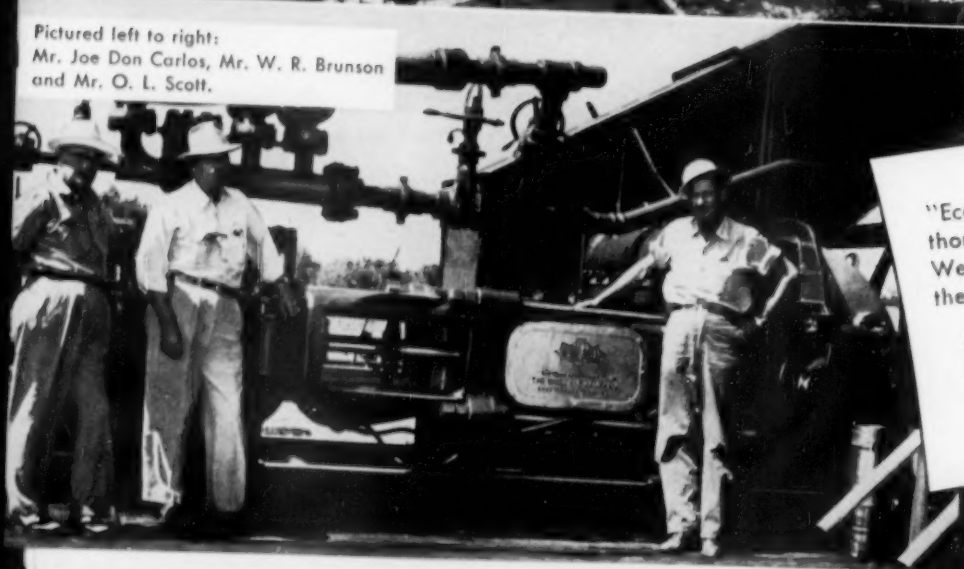
Bilbo-Redding Drilling Co., Inc.
Houston, Texas



Pictured left to right: Mr. Joe Don Carlos, Mr. W. R. Brunson and Mr. O. L. Scott.

"Economical operation . . . thoroughly field proven . . . We are very well satisfied with the HP-18000 Wheland Pump."

W. R. Brunson, Drilling Supt.
Dillard & Waltermire Drilling Co.
Wichita Falls, Texas

"Due to the economical operation . . . we believe it is field proven."

Carl Holliday, Drilling Supt.
Gibson & Holliman
Dallas, Texas

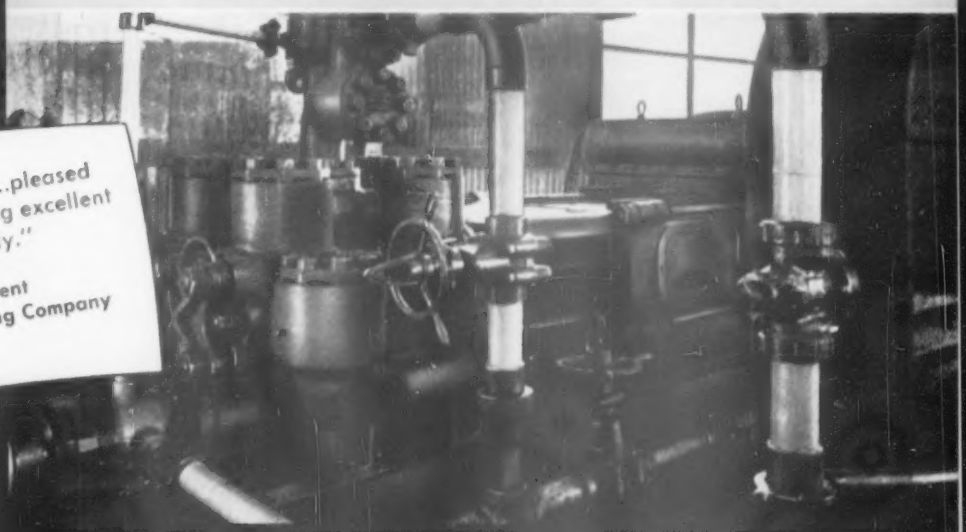
Pictured left to right:
Mr. N. L. Carter, Mr. Carl Holliday,
Mr. Jess Furreh and Mr. Carl Wilson.

How's this for results? Another HP-18000 Wheland pump operating in Southern Louisiana was scheduled to appear in this space—*but the well was made before the Wheland representative and photographer could reach the scene!*

Needless to say, the operators are delighted . . . Needless to say, the contractor depended on this Wheland pump to make the difference that makes his profit.

"Continues to do a good job...pleased with its performance...getting excellent service...recommend it highly."

J. L. Stauss, Vice-President
Falcon Seaboard Drilling Company
Tulsa, Oklahoma



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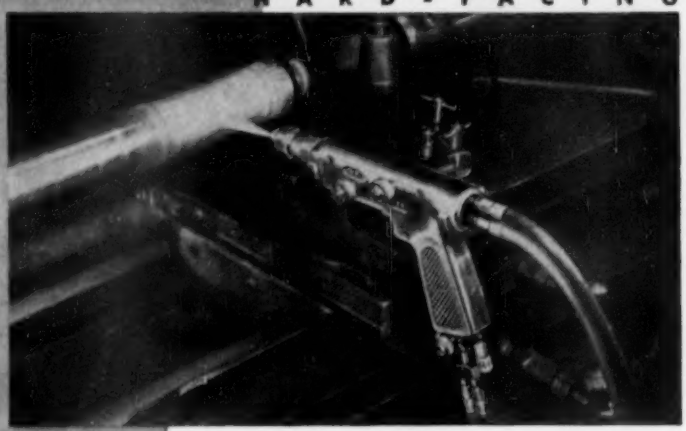
Fight corrosion with COLMONOY HARD-FACING



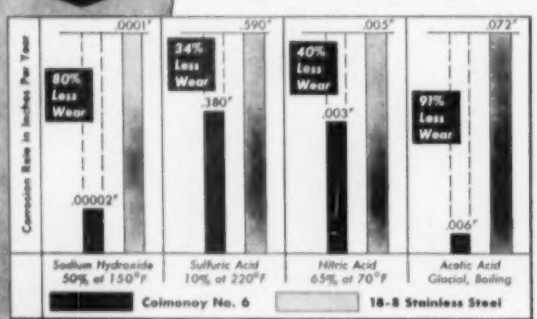
. . . one test showed the way!

Plagued by the corrosive effects of chemicals upon pump shafts and similar parts, a leading detergent manufacturer now Spraywelds with COLMONOY hard-facing to protect all such equipment subject to abrasion and corrosion.

There's no need to incur high replacement costs on your chemical handling equipment when parts can be protected with COLMONOY hard-facing to last many times longer than in their original form.

A single test will convince you too!

Table shows metal loss in inches per year of 18-8 stainless and Colmonoy No. 6, caused by the corrosive media indicated.



Write today for the Colmonoy Hard-facing Manual 77 and the Spraywelder Catalog.

Table above shows how COLMONOY No. 6 gives superior resistance to many corrosive agents, as well as to abrasion and galling.

There are several ways to apply COLMONOY alloys. Spraywelding is economical and the fastest way to produce a superior hard-facing on cylindrical, machined parts.

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TEXAS GULF COAST

San Patricio Discovery Indicates New Oil Field

A new oil discovery has been made in San Patricio County, in the lower coastal area. It is in a wildcat test Tex-Penn Oil & Gas Corp. is drilling south of Plymouth field, and between it and Taft field. It is 5 miles northeast of Taft townsite.

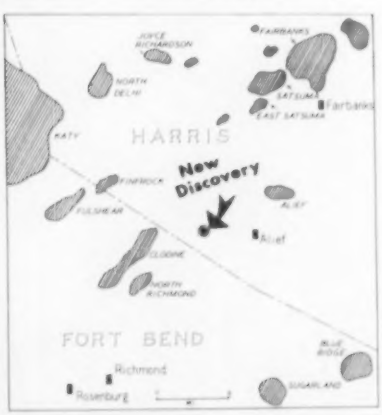
The discovery is in a 5,600-ft. sand, in which a 15-minute drill-stem test at 5,622½-26 ft. recovered 630 ft. of 33°-gravity oil. The test was through ¼-in. chokes. Flowing bottom-hole pressure gaged 550 psi., initially, and 450 psi. at the end. Shut-in bottom-hole pressure was 2,350 psi.

Present operators took over the test from Frio Drilling Co., Inc., and Logue & Patterson, who made the location as 1 Dimmick. Numbering by the present operators has been changed to 4 Dimmick.

Tri-Mark Oil Co.'s new discovery well, 1 Fowler, 4 miles north of Mathis, in the northwestern corner of the county, flowed 48.4 bbl. of 25°-gravity oil during a 24-hour production test through 3/16-in. choke. Flow was under pressure of 290 psi. from Frio sand perforated at 3,114-24 ft. Gas-oil ratio was 1,420 cu. ft. per barrel. Total depth is 4,725 ft. Location is in the John P. Borden Survey.

New Gas-Condensate Area Opens in Harris County

Standard Oil Co. of Texas is opening another new field in southwestern Harris County. Location is about 3½ miles west of Alief, and about 10 miles west of Houston's southwestern limits. It is about 1½ miles from the Fort Bend County line, and about 3 miles east of the northern end of that coun-



Where Standard Oil Co. of Texas is opening a new gas-condensate field in southwestern Harris County, near Fort Bend County line.

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with GUIBERSON GW CUPS

Save time.. save money.. save *fluid*.. with GW cups.. with Casing Swabs — products of Guiberson's more than a third century's experience serving the oil industry.

GW cups assembled on famous Guiberson Casing Swab

If you want to *swab* — not just agitate — flexible GW cups on the Guiberson Casing Swab will pull every drop. They hug the casing wall — provide automatic seal and controlled pipe contact — pull a vacuum and clean the well!

Precision molded in Guiberson's own rubber plant from special abrasion resistant compound, GW cups take up their own wear. They are unexcelled in rough or mixed casing strings and for unloading shallow wells. Won't down-swab or hang on casing collars. Interchangeable on the famous Guiberson Casing Swab.

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ty's Clodine field, nearest production.

Its discovery well, 1 George O'Leary, in the Blas Herrera Survey, is productive of gas and condensate. A drill-stem test of perforations at 7,797-7,805 ft. flowed the last 1¼ hours at the rate of 1,100,000 cu. ft. of gas per day through 3/16-in. choke. Gas carried 12.3 bbl. of 60°-gravity condensate per million cubic feet. Pressures were 2,550 psi., flowing, and 3,275 psi. shut in.

The test was open 232 minutes and started with a 3,000-ft. water cushion. It got a good blow immediately, had cushion at the surface in 7 minutes, and gas flow in 37 minutes.

Hole had been drilled to 8,750 ft. It was plugged back, sidetracked to 8,350 ft., and has casing to 8,335 ft. Initial perforations at 8,222-26 ft. tested salt water.

SOUTHWEST TEXAS

Oil Production Opened In New Duval Discovery

LaGloria Oil & Gas Co.'s new discovery well 13 miles northwest of Realitos in southwestern Duval County is rated good for 113 bbl. of oil per day. It opens Elva field.

Location (indicated by arrow) of LaGloria Oil & Gas Co.'s new oil-discovery well in Elva area, southwestern Duval County.

Production was gaged through a P-42 choke with pressure of 225 psi. Flow through ⅛-in. choke was at the rate of 24.79 bbl. per day with pressure of 20 psi.

Hole was drilled to 3,607 ft. and has oil-string to 3,507 ft. Casing is perforated at 3,524½-30 ft., in Yegua sand.

The well, 2 Dinn, is 2,100 ft. of 1 Dinn, dry hole drilled by Continental Oil Co. LaGloria is drilling a confirmaion test, 3 Dinn, 933 ft. northeast of the discovery well. The area is 1½ miles northwest of Cox & Hamon field, nearest production.

Deep McMullen Wildcat Tests Condensate Shows

Indications of gas-condensate production have been encountered in a deep wildcat test being drilled by Argo Oil Corp. in southeastern McMullen County. The wildcat, 1-T Edrington, is southwest of the shallow Rhode gas area, and about 8 miles northeast of Seven Sisters.

Three drill-stem tests in a sand section below 7,900 ft. got good showings of gas and condensate. First test, at 7,911-24 ft., open 15 minutes through ¼-in. chokes, had working pressure of 840 psi., with bottom-hole flowing pressures of 3,010 to 3,210 psi., and recovered 15 ft. of condensate with 6 ft. of mudy water. Shut-in pressure was 4,010 psi.

Second test was at 7,926-40 ft. with tool open 9 minutes through ¼-in. chokes. Working pressure was 620 psi., with bottom-hole flowing pressures of 3,705 to 3,780 psi. Recovery was 15 ft. of condensate. Bottom-hole shut-in pressure was 4,045 psi.

Third test, at 7,941-55 ft. with tester open 12 minutes, had working pressure of 800 psi., bottom-hole flowing pressure of 3,570 to 3,775 psi., and recovery of 40 ft. of condensate with 15 ft. of muddy water.

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ROCKY MOUNTAIN

MONTANA

New Pay Indicated at East Poplar Field

The Kibbey sand is an indicated new pay zone for East Poplar field, Roosevelt County. Murphy Corp. recovered 2,093 ft. of free oil on a drill-stem test at 5,236-50 ft. The operator also got 3,821 ft. of gas, 60 ft. of oil and gas-cut mud. Gravity of the oil is 39°.

A previous test at 5,253-65 ft. recovered 3,677 ft. of gas, 90 ft. of oil, 60 ft. of oil and gas-cut mud and 3,322 ft. of salt water. This is the first good showing of Kibbey oil in the field, although other wells in the area have had some showings. The field proper produces from the Madison at about 5,600 ft. There is also possible production from the Heath sand in the field, but no wells have completed in this zone.

NORTH DAKOTA

Confirmation Well Begins At Renville Discovery

Location for two new wells in the discovery area around Sohio Petroleum Co.'s 1 Ritter have been announced. Sohio 1-B Ritter, NW NW 24-163n-86w, Renville County, and 1-C Ritter, SE SW 13-163n-86w, will test the Charles. The 1 Ritter discovery well is located in SE NE 23-163n-86w, and is shut in for market.

WYOMING

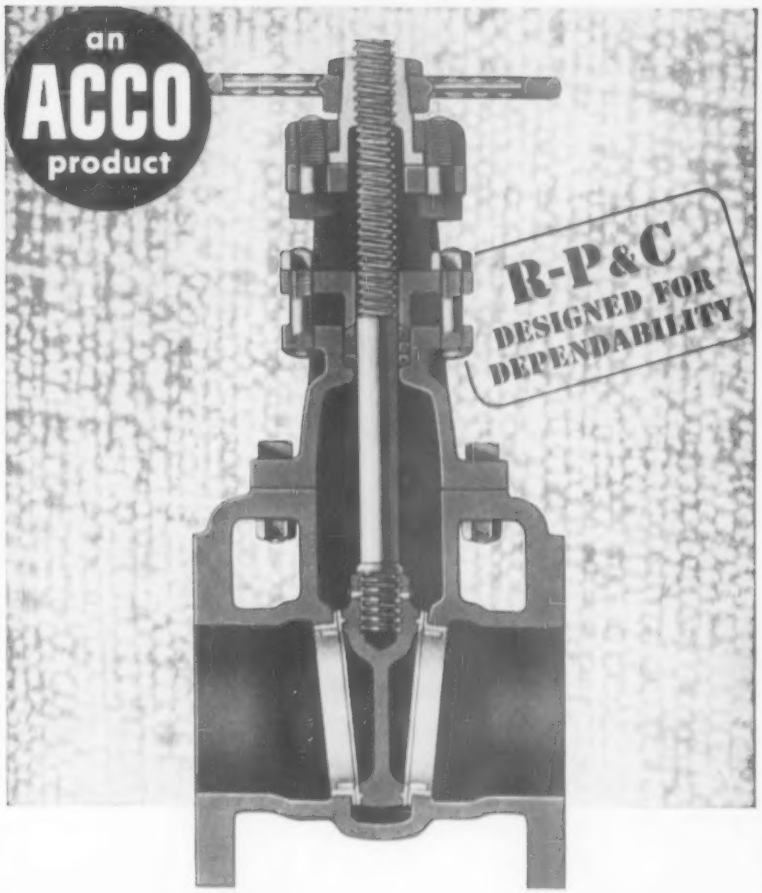
Casing Run at Hogsback Frontier Discovery Well

General Petroleum Corp. has run casing at its 87-19 Unit in NE SE SE 19-27n-113w, in the Hogsback Unit of Sublette County. This apparent Frontier sand discovery recovered a combined total of 6,000 M.c.f. of gas per day from perforations.

This is the first test for this unit. The unit lies on the western flank of the Green River basin about 3 miles east of LaBarge field.

Casing Run at Sage Spring Creek Dakota Discovery

Casing has been run at Amerada Petroleum Corp. 36 Sage Spring Creek in C NW NE 12-37n-78w, Natrona County. This well is an apparent discovery at 6,555-71 ft. in the Dakota. Recovery on a test was 5,471 ft. of clean 34°-gravity oil.



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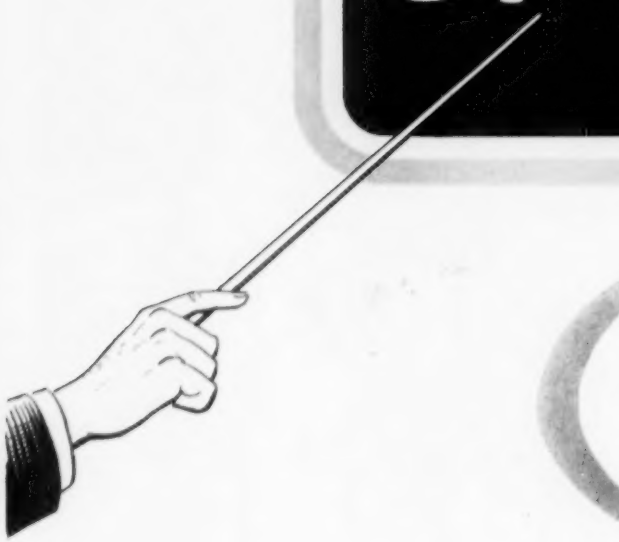

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HOUSTON, TEXAS

Northwest Sheldon Tensleep Discovery Is Pumping Oil

Skelly Oil Co. pumped 95 bbl. of oil in 15 hours at 4-T Tribal, Tensleep discovery in NW SW SW 36-6n-3w, Northwest Sheldon Dome field, Fremont County.

Perforations in the Tensleep are at 4,819-34 ft. The well also is an indicated Phosphoria discovery on the basis of drill-stem tests. The field produces from Triassic-Curtis sand at about 3,350 ft.

Phillips Reports Gas Shows At Deep Sublette Wildcat

Gas shows have been reported at the 1 Unit in C NW NE 21-31n-111w, Sublette County, by Phillips Petroleum Co. The Daniels Unit wildcat, nearing 16,000 ft., was originally slated to go to 12,500 ft. in the Mesaverde. There have been no tests run at the wildcat and no cores reported bleow 12,000 ft.

COLORADO

New Pay at West Messex

Delta Drilling Co. and Arrowhead Exploration Co. are putting up pump at 2 State, SW SE NW 35-6n-55w, new pay discovery at West Messex.

The well is producing from perforations at 5,166-70 ft. in the "J" sand. Total depth is 5,280 ft. The well swabbed 55 bbl. of oil per day.

Weld County test abandoned . . . Skelly Oil Co. has quit the 1 Samber in NE NE NE 22-7n-56w, Weld County wildcat. Water was recovered on tests of the "J" sand and "D" sand at 5,848-54 and 5,750-54 ft., respectively. This well is 4 miles southeast of Stoneham, Colo.

BASIN AND RANGE

NEVADA

Richfield Plans Nevada Test

Richfield Oil Corp. plans to make its first test in Nevada. Richfield will drill a wildcat, on a farmout from Gulf Refining Co., on a site in the Rabbit Creek unit, approximately 10 miles east of Elko.

PACIFIC COAST

CALIFORNIA

Union Puts Pump on San Mateo Wildcat

Union Oil Co. was waiting last week for the drilling company to move off the location before completing its 1 Costa wildcat in San Mateo County on pump. This wildcat, located SE NW 14-8s-3w, had two successful tests at intervals between 2,100 and 3,000 ft. These reports make it appear likely Union has made a new field discovery in the Boulder Creek area of the northern California county.

This wildcat has touched off a flurry of leasing activity in the Santa Cruz Mountains despite at least six previous failures by other companies in the region. While all reports are unofficial on production statistics, the well, with

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The HERCULES Oil Reservoir Upper Gland was designed primarily for "problem" wells which pump-off and burn the stuffing box packing. The polished rod moves through the oil in the reservoir which lubricates and helps cool it. The reservoir capacity is one fluid quart. The Split Cone Packing Ring (located between the Oil Reservoir Gland Body and Cap) is used to control the oil film on the polished rod on the "up stroke." On the "down stroke" it wipes off the excess oil and the dust or sand which invariably collects on the rod. The Reservoir Gland Cap channels the excess oil and dirt back into the oil reservoir. The dirt will then "settle out" and can be removed from the reservoir through the drain plug.

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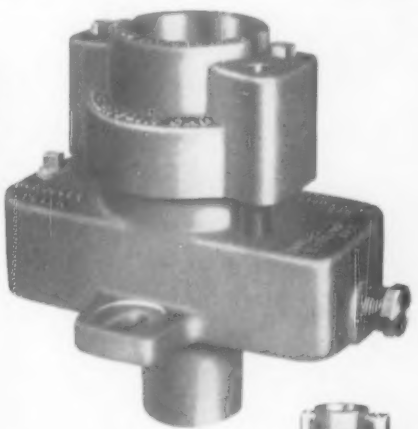
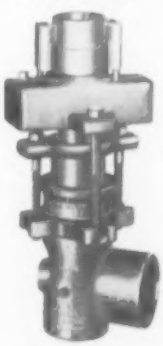
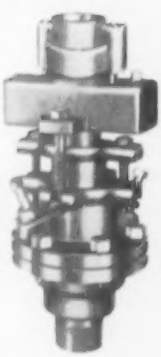




"TEE BASE TYPE"



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The three illustrations show all the famous HERCULES Duplex Polished Rod Stuffing Boxes equipped with the New Oil Reservoir Upper Gland.

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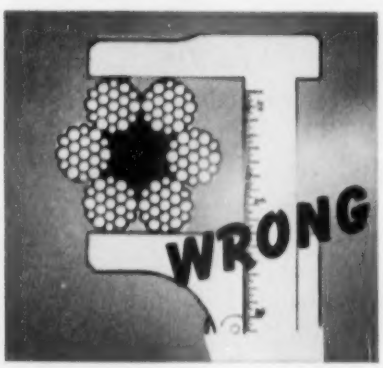
Tuffy tips on choosing the

Measure Groove Diameter Accurately

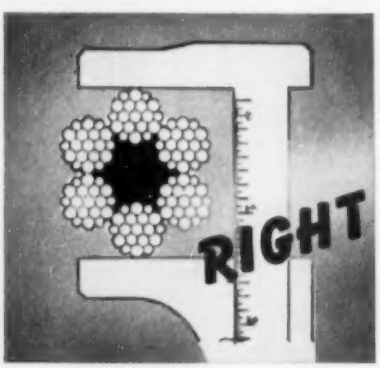
Shown above is the WRONG way to measure the groove diameter. The result—shorter life of the wire rope you buy. Note that only the sides of the rope will bear on the sheave. In a relatively short time this will squeeze the rope out of round and set up destructive friction and stresses on the rope strands and wires. New rope is oversize and diameter of grooves on sheaves and drums should be slightly larger.

Shown above is the *CORRECT* way to measure the groove diameter. It is a simple thing to do and will give the rope you buy a chance to deliver all the service it possibly can. Remember a wire rope is composed of many closely correlated working parts and sheave grooves which are too large or too small throw them out of alignment. Just like any other working part on a machine, wire rope cannot do its best if it is misfitted.

If Present Rope Is Correct Size, Measure with a Caliper



Measuring the Wrong Diameter is a common mistake that some buyers make when they order replacement rope. When the rope arrives, it turns out to be too small—even though a machinist's caliper was used to assure accuracy. It's an easy mistake to make, but it's just as easy to remember the *right* way and be sure you get the right size rope. Otherwise both the safety factor and service life of the rope will be reduced.



Measuring the Right Diameter is the simple step shown above. Measure so that a single strand is on each of the adjustable edges of the caliper—*not* two strands that measure as a flat side. The actual diameter of a wire rope is the same as that of the circle required to circumscribe it. The diameter of a wire rope is an important factor in determining the safe working load to be handled by your equipment.

Replace Worn Sheaves

When Replacing Rope, check for sheaves that have been badly worn. Sheaves that have grooves corrugated by the rope lay impression should be replaced immediately before installing new rope. Since rope creeps to a certain extent on sheaves these grooves can actually cut the strands as the rope runs over. This will greatly reduce service life of *any* wire rope.

right replacement Rope

Beware of Critical Tread Diameters

It is highly important to accurately measure the tread diameter of the smallest sheave or drum on any machine. Here's why. It is on this sheave or drum that the wire rope will get the greatest wear. Some constructions of wire rope will work on smaller tread diameters than others without lessening their service life. Engineers have determined the critical tread diameter for different constructions as shown in the table at the right. Also shown in the table is the minimum recommended tread diameter which is 50% larger than the critical tread diameter.

Example, the tread diameter of your smallest sheave is 24 inches. You know that a 1-inch rope is necessary. Referring to the table at the right you see that the 6 x 19 Warrington or Filler wire is suitable because the minimum tread diameter recommended for it is 24 times the diameter of the 1-inch rope. This gives you a margin of 50% over the critical diameter of 16 inches. If flexibility is a factor in the operation then you would choose the Filler wire type of rope with fiber core.

Construction of Rope	Critical Tread Diameter	Minimum Recommended Tread Diameter
6 x 7	28	42
18 x 7	24	36
6 x 19 Seale	20	30
6 x 19 Warrington or Filler Wire	16	24
6 x 31	15	22
8 x 19 Seale	14	21
6 x 37	12	18
8 x 19 Warrington or Filler Wire	12	18

To arrive at critical tread diameter and minimum recommended tread diameter multiply the numbers above by the rope diameter.

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Stemming from many years of cooperation with users and machine builders mastering wire rope problems, is a family of special ropes for special purposes. Into each is incorporated the rope construction, the grade of steel and operating characteristics found to be best for the service for which each is intended.

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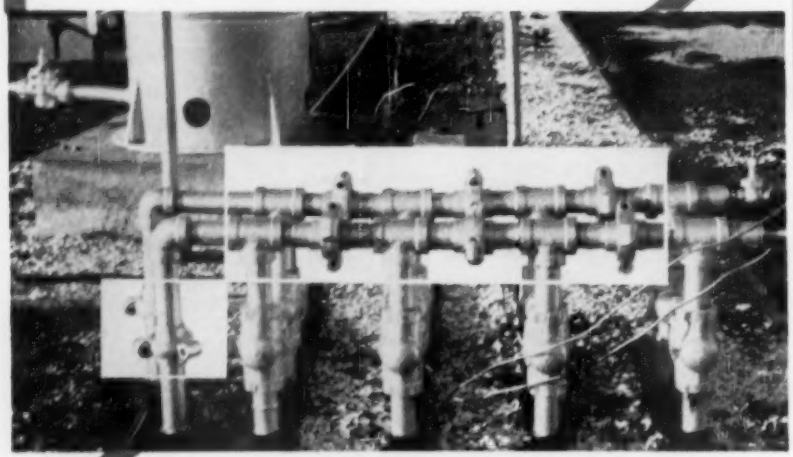

for a PRODUCTION HEADER

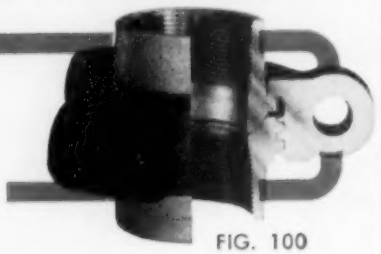

FIG. 100

WECO UNIONS

• Perfect because these WECO Fig. 100 Unions make-up easily and quickly—because their ball and cone seat seals, and stays sealed —because the "Bar-Nut" permits tightening with an ordinary bar or hammer.

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HOUSTON, TEXAS
Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

WECO ®

total depth at 3,804 ft., flowed 41°-gravity crude on earlier tests.

Standard Hits Possible New Vedder Pool

Possibility that Standard Oil Co. of California had hit a new Vedder pool in the northwest end of Greeley field was seen from early reports on its 202 Clarksig. A formation test at the interval 11,480-11,500 ft. flowed clean 36°-gravity crude. Production is probably from either the third Vedder pool found in other parts of the field, or, the same as the Helbling pool of Rio Bravo field. Most likely choice is the Helbling sand due to the nearness of Rio Bravo field.

Richfield Extends Wheeler Ridge Production

Richfield Oil Corp. extended the proved production limits of the Reserve sand in the Wheeler Ridge area with the completion last week of 38-22 Hagood. This well, located SE SW 22-11n-20w, was brought in on pump for 90 bbl. daily of 17.6° crude through an 18/64-in. choke. The well is producing from the interval 5,100-73 ft. Completion of this 8,362-ft. well extended the field ½ mile north of the main Wheeler Ridge field production.

WESTERN CANADA

ALBERTA

Second Drill-Stem Test at Savanna Creek Flows Dry Gas

The second drill-stem test at the Savanna Creek 2-A gas success flowed dry gas at measured rate of 9,500 M.c.f. per day, it was revealed by Phillips Petroleum Co.

The assured gas producer, 2-A Savanna Creek, LSD 5, 21-14-4w5, like the discovery in the area, is a joint operation of Phillips, Husky, and Northern Natural Gas Producing Co. Although initial test in the top of the Madison flowed gas at 8,400 M.c.f. per day and this second test flowed at an even higher rate, it is felt by company officials that the main pay horizon found at the discovery has not been contacted by this follow-up well.

The 2-A Savanna Creek is 33 miles west and slightly south of Nanton, 65 miles south of Calgary, and 24½ miles southwest of Turner Valley field. Turner Valley, which was Canada's first major oil field, was opened in 1914 on the same type of structure as Savanna Creek wells. Both are Madison anticline producing zones.

The latest test at the well in Savanna

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THE BAASH-ROSS AUTOMATIC WIRE LINE WIPER

Whenever a wire line job is run, especially when pressure is involved, this tool assures safer and more efficient working conditions.

- It latches on automatically when running in.
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- Replaceable bronze guides above and below the packing prevent sparking and wear on the wiper body.
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Creek of the interval 7,827-7,966 ft. flowed at the rate of 9,500 M.c.f. per day, and there was no pipe recovery when pipe was pulled.

Gas Flow Reported at Chinook Ridge Wildcat

Stanolind Oil & Gas Co. recorded a gas flow of 1,000 M.c.f. per day in the Viking sand at its A-1 Chinook Ridge wildcat on LSD 3, 12-65-13w6, 55 miles southwest of Grande Prairie and 82 miles southeast of Dawson Creek in far Northwest Alberta.

Discovery drill-stem test in the Viking of the interval 9,070-9,143 ft. flowed gas at the rate of 1,000 M.c.f. per day by the end of the test. The company plans to continue coring and testing operations immediately. This wildcat has been called Canada's "wildest wildcat."

ALBERTA

Light Oil Discovery Seen For Morinville Area

An indicated light-gravity crude oil discovery at a wildcat in the Morinville area of central Alberta was reported by Sharples Oil (Canada), Ltd. This wildcat is 11 miles north of Edmonton and ½ mile north of Carbondale.

The indicated producer, Sharples 6-17 Carbondale, LSD 6, 17-55-24w4, is 7 miles northeast of Sharples 13-5 West Volmer, while the nearest previous tests were abandoned. The basal quartz was topped at 3,520 ft. Sharples announced it will drill the balance of the section before running a protective string. When the casing has been set the operator will continue to drill the scheduled Cooking Lake test.

During the first drill-stem test in the pay zone, the well gave a recovery of 30 ft. of light oil and registered a gas flow of over 8,000 M.c.f. per day. Interval tested was 3,520-70 ft.

Blairmore Oil Discovery Reported at Crawling Valley

A well, reported as a gas discovery in the basal Colorado formation recently, has indicated the discovery of medium to light-gravity oil in the basal Blairmore. This well is operated by Mobil Oil of Canada, Ltd., and according to the latest report the wildcat yielded a pipe recovery of 1,900 ft. of clean oil during a drill-stem test in the detrital zone of the basal Blairmore.

This dual zone strike, Mobil-CPR 17-7 Crawling Valley, LSD 7, 17-23-18w4, is 5½ miles south of Makepeace town and 60 miles east of Calgary. Detrital drill-stem test was run at 4,182-4,228 ft. Gas flowed to surface at a rate too small to measure after 10 minutes. Pipe recovery consisted of 160 ft. salt water mud emulsion in addition to the 1,900 ft. clean oil. Earlier the well was reported as a gas discovery in the basal Colorado, topped at 3,695 ft. Gas discovery drill-stem test of the interval 3,694-3,750 ft. flowed at a maximum daily rate of 4,720 M.c.f. per day.

HUGOTON EMBAYMENT

OKLAHOMA PANHANDLE

New Pay Discoveries Feature Texas County Activity

Pipe has been set at a very important geological test on the east side of Guymon-Hugoton field in Texas County. Panhandle Eastern Pipe Line Co. 2-18 Enns, C NE SW 18-3n-18eCM, gaged 3,020 M.c.f. of gas at the end of 10 minutes on a test of the Morrow sand at 6,237-54 ft., open 30 minutes. It made an estimated 5,000 M.c.f. daily in 15 minutes. Another test at 6,267-91 ft. made 4,735 M.c.f. per day with recovery of 45 ft. condensate-cut mud and water reported.

Camrick district . . . Mississippian gas production has been opened in the Camrick area at Kansas-Nebraska Nat-

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Straight Grip

TOOL JOINT

In areas where tool joints must be replaced before the drill pipe is retired—or where tool joints outlast the drill pipe, American Iron hand-applied Straight Grip tool joints offer your best investment.

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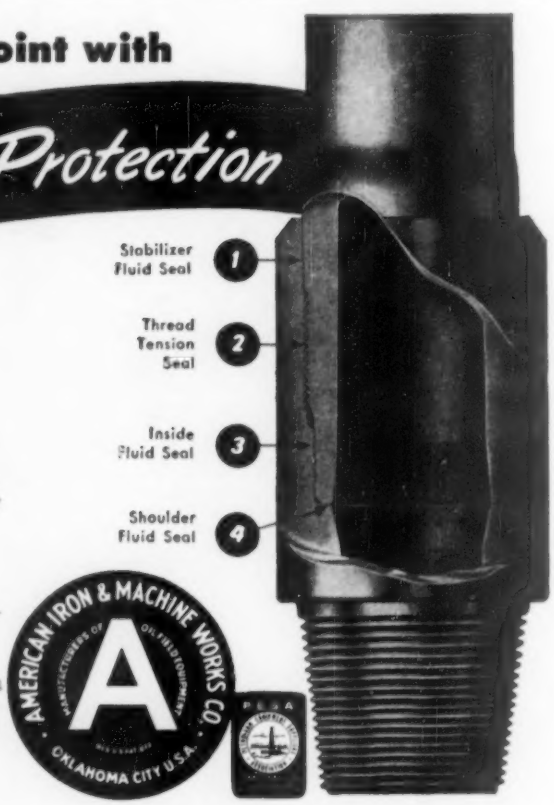

ural Gas Co. 1 Westmoreland-C, SW SW NE 26-1n-18eCM.

The well flowed 5,684 M.c.f. of gas per day after treatment with tests continuing. Perforations were made at 7,160-70 ft.

Tri-Zone Producer Reported At West Mocane Well

Three zones of production are indicated at a West Mocane field well in Beaver County . . . the Checkerboard, the Marmaton, and Chester.

United Producing Co. has the three-pay strike at 5 Adams, C SW NE 36-6n-24eCM. Checkerboard pay is indicated at 5,392-5,406 ft.; in the Marmaton at 5,590-5,600 ft., and also at 5,656-67 ft.; the Chester-Mississippian showed gas at 6,230-48 ft. Oil flowed at an estimated 50-60 bbl. per hour with recovery of 2,000 ft. of 27°-gravity oil reported.

TEXAS PANHANDLE

Dual Ochiltree County Discovery Completed

Woodson Oil Co.'s dual discovery in north-central Ochiltree County, the 1-A Perry Unit, has been completed as an oil discovery in the Seven Fingers (Pennsylvanian) lime and a gas discovery is indicated in the Morrow sand.

The well flowed 330 bbl. of oil daily on ½-in. choke from perforations in the Seven Fingers lime. Gas flowed at a calculated open flow rate of 8,000 M.c.f. per day during drill stem tests in the Morrow sand at 7,766-80 ft.

ARK-LA-TEX

NORTH LOUISIANA

Two Discoveries Plus New Pays and Extensions

September exploration in North Louisiana was featured by two new oil pool discovery wells, one new-pay discovery in an older field, and three extension wells.

F. R. Jackson 1 Louisiana Delta Hardwood Lumber Co., Inc., in SE NE 10-6n-4e, Jackson Parish, opened French Fork field. The well flowed 25 bbl. of oil per day from the Wilcox sand at 4,458-59 ft.

Newlight field . . . Chicago Mill & Lumber Co. 1 fee in C SW SE 9-13n-10e, opened this Tensas Parish field. The well flowed 66 bbl. of 39.8°-gravity oil per day on 8/64-in. choke from perforations in the lower Tuscaloosa at 7,410-15 and 7,420-32 ft.

Cane River well . . . Homer field in Claiborne Parish got its first Cane River production at McCalman Drilling Co., Inc., 1 Oakes Account No. 1, SW NW 29-21n-7w. The well finaled pumping 3 bbl. of oil per day from perforations at 622-646 ft.

Good Pettet Oil Well Finaled at Redland

Redland field in Bossier Parish, northwestern Louisiana, has a good new Pettet oil well at Sunray Mid-Continent Oil Co. 1 Covington, C N½ NE SE 29-23n-12w. The well made 624 bbl. of oil per day on ⅛-in. choke. Perforations were at 6,276-87 ft.

Dry Gas Reported at North Gibsland Discovery

Trans-Tex Drilling Co. has a new dry gas discovery 3½ miles northwest of Gibsland in southern Claiborne Parish, north-central Louisiana. The 1 Drake in C SW SE 32-19n-7w, is shut in after flowing dry gas on a ⅛-in. choke from the Tokio sand at 2,820-40 ft. An offset well is being drilled 1⅜ miles northwest at B. S. & M. Drilling Co. 1 Feitel in SW SE 30-19n-7w, 5 miles northwest of Gibsland.

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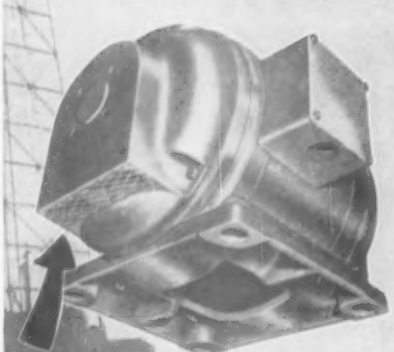
The FIELDMASTER has many other **outstanding advantages** that our distributor, the BETHLEHEM SUPPLY COMPANY, will be happy to show you. May we have them contact you . . . **without obligation?**



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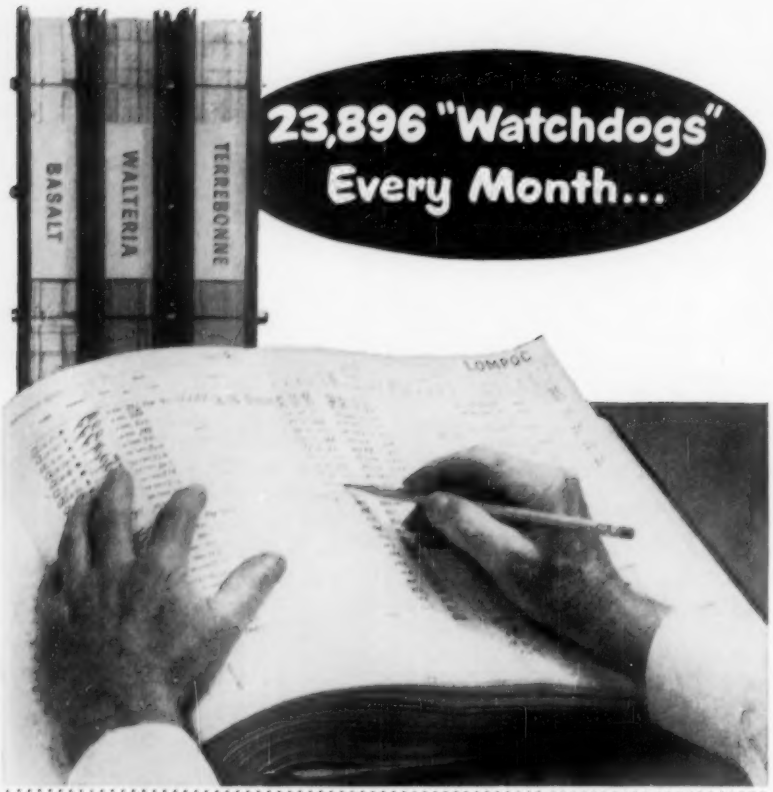
Distributor, BETHLEHEM SUPPLY CO., TULSA, OKLA.



That's the *average* number of laboratory tests we make each month to insure that every run of every Dicalite product will render uniformly high performance. (The actual number varies, and depends on the different Dicalite products run.)

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Hence, the tests continue, lot after lot, recording flow rate, cake density, color, porosity, specific gravity and other characteristics. And our customer's laboratories often back us up with their own tests, giving high reports on Dicalite quality, Dicalite uniformity, and, all-important—Dicalite dependability.

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ARKANSAS

September Exploration Nets State Three New Pay Hits

Three new oil pays were established in Arkansas fields during the first month of autumn.

Lawton Oil Corp. completed wells in two new pay zones in Columbia County's Dorcheat - Macedonia field. The A-1 Caldwell-McWilliams, C SW SE 13-18s-22w, is a dual Cotton Valley sand gas-condensate producer. The well made 84 bbl. of condensate on 15/64-in. choke. Perforations were at 8,124-42 ft. It also made 50 bbl. from 8,020-39 ft.

Miller County . . . The Paluxy became a new pay in new McKinney Bayou field in southwestern Arkansas.

Milam & Crank 1 Crank, C W½ SE NW 13-16s-26w, ⅝ mile from Tuscaloosa oil production in McKinney Bayou field, flowed 336 bbl. of oil per day from Paluxy perforations at 3,929-33 and 3,934-36 ft. Further Tuscaloosa, Mooringsport, and Paluxy sand development is expected in this area.

West Woodley field extended . . . This shallow Union County field was extended ¾ mile to the northwest at Alpuente & Cook 1 Defee & Marrable et al, C NW SW SE 34-17s-15w. The well pumped 18 bbl. of oil from perforations at 2,149-2,249 ft.

EASTERN INTERIOR

ILLINOIS

In White County L. D. Sawyet 3 Blackford, NE SW SE 25-3s-10e, is to test the O'Hara lime at 3,066-71 ft. Recovery on a drill-stem test was 1,060 ft. of clean oil, 30 ft. of oil and gas-mixed mud. This well is 3 miles southwest of Grayville and ¾ mile from O'Hara production.

- In Bond County, 7 miles northwest of Greenville, Joe Simpkins 1 Burkhardt, NE SW NW 16-6n-4w, has been completed flowing 1,440 bbl. of oil per day, natural, from the Dutch Creek sand at 1,835-45 ft.

APPALACHIAN

OHIO

After several attempts, an oil pool has apparently been found east of New Guilford in Perry Township, Coshocton County. The discovery was completed by Pure Oil Co. on 1 Harry Lee, Section 8, and logged the Clinton at 3,288-3,331 ft. with a produc-

tion of 40 bbl. in 24 hours after fracturing. One of the largest initial producers in this township was completed by Penn Oil & Gas Co. on 3 (4) E. E. Mercer in Section 5. Sand at 3,255-3,307 ft. made 300,000 cu. ft. with a good oil showing natural and 400 bbl. in a 24-hour test after fracture treatment.

● A wildcat on R. R. Riffle, Section 16, Fairfield Township, Washington County, is being drilled by B. H. Putnam et al to test the Ohio shale and possibly deeper horizons.

WEST VIRGINIA

In Clover district, Tucker County, West Virginia, Hope Natural Gas Co. is grading road to No. 9967 Walter Hovatter, wildcat, elevation 2,016 ft., Belington Quadrangle, 3.2 miles south of latitude 39 degrees 15 minutes and 1.68 miles west of longtitude 79 degrees 45 minutes.

● In St. George district, Columbian Carbon Co. 1215 U.S.A. is drilling at 4,291 ft., and in No. 1219 U.S.A. ran 8⅝-in. casing and is drilling at 1,088 ft.

● In Licking district, Hope Natural Gas Co. 9949 W. Asa Street gaged 994,000 cu. ft. of gas after Hydrafrac in the Oriskany sand and shut down.

● Union district, Preston County, Cumberland & Allegheny Gas Co. 535 C. R. Lipscomb is drilling at 4,384 ft.

● In Grant district, Plymouth Oil Co. 1, Glen Herring, 2,087 is at 4,000 ft.

In St. George district, Tucker County, West Virginia, Columbian Carbon Co. 1215 U.S.A., wildcat, elevation 1,639 ft., will be drilled to the Clinton sand. The last recorded formation was the Helderberg, topped at 3,688 ft. No appreciable increase of the gas in the chert was encountered after Hydrofrac. No. 1219 U.S.A., is spudding.

● Sherman district, Hampshire County, M. E. Anderson 1 J. E. and B. Orndorff, is drilling at 6,016 ft.

● Roaring Creek district, Randolph County, Seneca Gas & Oil Co. 1 Simon K. Scott, is drilling at 1,397 ft.

● Dry Fork district, Hope Natural Gas Co. 9957 U.S.A., Department of the Interior is building the rig.

GREAT LAKES

MICHIGAN

Flowing at a restricted rate of between 8 and 10 bbl. of oil an hour from Traverse oil pay, and checking in from 100 ft. to 40 ft. higher on this objective than correlating control points,

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Jacks

"Giving Industry A Lift Since 1883"

the Klondike Petroleum Co., Inc., 1 Hoge, NE SE SE 5-14n-14w, Denver Township wildcat, Newaygo County, was completed this week as one of the most significant new "West-State" oil strikes since 1948.

Top of Traverse lime at the 1 Hoge was logged at 2,101 ft. Gas, estimated at 750,000 cu. ft. a day, showed between 2,101 and 2,102 ft. First oil, and this was not in commercial amounts, showed between 2,109-10 ft., with additional oil pay uncovered by deepening to 2,111 ft., total depth. Well swabbed and flowed about 30 bbl. of oil natural in 10 hours on test. After a 1,000-gal. acid treatment, production was jumped to a high of 35 bbl. of oil an hour, at which rate well was flowed for 4 hours before being restricted to 10 bbl. an hour, and later to about 187 bbl. daily. No water was reported to be showing.

Klondike, this week, had drilling machine rigged up in the NE NE NE 8-14n-14w, for first follow-up test to new producer, at the south 40-acre offset to the discovery.

Carter Oil Co., with a spread of leases in the play, including the east offset to the discovery, is expected to announce a location for immediate drilling.

Bulk of acreage in this new Newaygo County area is under lease to Klondike and associated companies, and Carter Oil Co. Others with leases that may be proved up with additional drilling include Pure Oil Co. and Muskegon Development Co.

● Recompletion of an early Dundee-Reed City zone objective failure in Reynolds oil field, Montcalm County, resulted in a new, shallower Traverse oil discovery for the pool at the McClure, Swan-King, Basin Oil Co. and G. Ackerman 1 Williams, SE NW SE 1-12n-10w. Well was plugged back from original total depth, 3,386 ft., to 2,791 ft. and Traverse oil pay at 2,787-91 ft. was acidized with 500 gal. While first reports from well showed for as little as 13 bbl. of oil daily, as production testing has been continued, amount of oil recovered has been on the increase. Well was rated good for 20 bbl. of oil a day, but production actually has now increased to about 30 bbl. daily. Although considerable water is produced from Traverse along with the oil, the percentage of water has not increased as oil production improved.

This successful Traverse completion may stimulate additional shallower completing in the Reynolds pool and will prompt operators to keep a close check on this zone in every well. Top of Traverse lime was logged at 2,787 ft.

Successful Wildcats

ALABAMA

Mobile County: Zach Brooks Drilling Co. 1 Donovan, SE SW NW 25-2n-3w, IP 342 BOPD, ¾-in., 45.1°, perforations 10,870-90 ft., 10,912-22 ft., and 10,950-59 ft. (upper Rodessa), and (dual completion) 53 BOPD, ½-in., 41.8°, perforations 11,275-88 ft., 11,378-84 ft., and 11,389-11,414 ft. TD 11,517 ft. Elev. 318 ft., Lower Cretaceous 7,505 ft., base anhydrite 10,660 ft. (New field—Citronelle.)

ARKANSAS

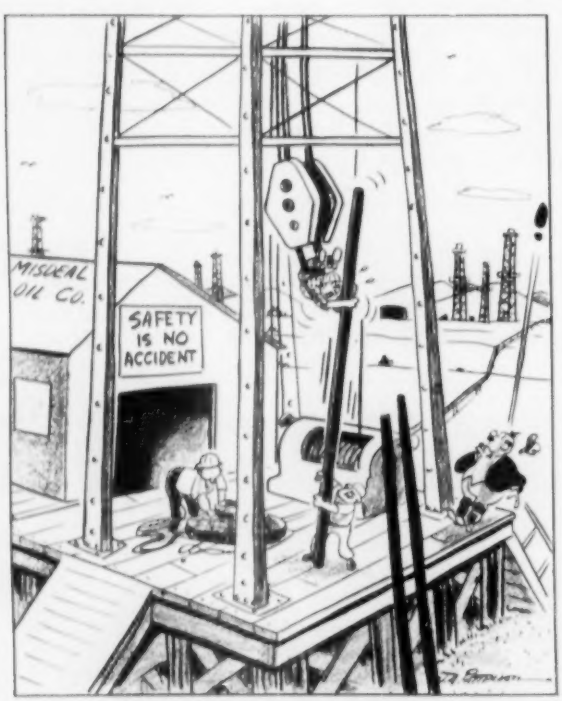
Miller County: New pay discovery in Fouke field. Carter Oil Co. 1 Juanita Harvey, 32-16s-26w. IPF 93 BOPD, first Tokio sand 2,876-84 ft., ¼-in. choke, 32.3°. TD 3,656 ft.

New pay in McKinney Bayou field. George Belchic, Jr.-Mercury Drilling Corp. et al 1 Purifoy et al, NW¼ 23-16s-26w. IPP 196 BOPD, Morringsport 4,059-69 ft., 46°. TD 4,162 ft.

Pope County: New pay in Moreland field. Murphy Corp. 1 McGuire, 1⅞ miles southwest of Moreland and 5,500 ft. southwest of the discovery well in C SW NE 15-8n-19w. IP 2,930 M.c.f. of dry gas per day, Atoka sand 4,422-66 and 4,494-4,509 ft. TD 5,464 ft.

CALIFORNIA

Kern County: Ferguson & Bosworth 5 Honolulu-Layman, NW NE 18-28s-20e, IPP 120 BOPD, 26° gravity, perfs. 2,792-2,816 ft., TD 3,650 ft. (New fault block pool NE of McDonald Anticline field.) Richfield Oil Corp. 38-22 Hagood, SE SW 22-11n-20w, IPP 115 BOPD, 17.3° grav-



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TRUCO DIAMOND BITS AND D & S CORE BARRELS

ity, 18/64-in. choke, perfs. 5,100-73 ft., TD 8,362. (New pool discovery ½-mile north of Wheeler Ridge field.)

Los Angeles County: Tide Water Associated Oil Co. 1 McGinley, NW SW 6-2s-11w, IPP 15 BOPD, 27 BWPD, 19.2° gravity, perfs. 3,568-3,641 ft., TD 7,245 ft. (East extension to Montebello field.)

COLORADO

Morgan County, Arroyo Creek: Arrowhead Exploration-New Drilling Co. 1 Jones, C SE SE 1-2n-59w. IPF 283 BOPD, "D" sand discovery, new field. TD 6,130 ft. Skull Creek.

Weld County: Lowell J. Williamson 1 Duell, C SW SE 25-8n-60w. IPF 510 BO in 17 hours. "D" sand discovery, new field. TD 6,945 ft. "J" sand.

KANSAS

Barber County: Aurora Gasoline Co. 1 Long, SE SE SW 24-33s-12w. IP 2,400 M.c.f. of gas per day, ¾-in. choke. Mississippian 4,541-60 ft. TD 5,190 ft. (Gas discovery.)

SOUTH LOUISIANA

Acadia Parish: Humble Oil & Refining Co. 1-B Joseph Habetz, 15-9s-1e (2¾ miles S of North Crowley field). IP 180 BOPD, 1/16-in., 42.7°, GOR 800 cu. ft. per bbl., perforations 12,203-19 ft. TD 13,598 ft. (New field—Wickoff Bayou.)

Lafourche Parish: Natural Gas & Oil Corp. and Humble Oil & Refining Co. 1 LL&E, 30-19s-23e. IP 59 BCPD and 2,680 M.c.f. daily, 5/32-in., 54°, perforations 12,528-40 ft. TD 12,774 ft. (New pay in East Golden Meadow field.)

St. Mary Parish: Magnolia Petroleum Co. 1-B State Lease 696, Blk. 129, Eugene Island area, Gulf of Mexico. IP 351.12 BOPD, 13/64-in., 36.9°, perforations 11,582-94 ft., and (dual completion) 446 BOPD, 11/64-in., 40°, perforations 10,424-36 ft. TD 13,900 ft. (New pays in Eugene Island Block 128 field.)

Terrebonne Parish: Humble Oil & Refining Co. 1-R LL&E, 5-19s-14e. Potential gas well, perforated 12,012-18 ft., tested ungage volume of gas, squeezed perforations, standing. TD 14,670 ft. (Indicated new gas field.)

Humble Oil & Refining Co. 1-T LL&E, N 21° 53' E 12,541 ft. from USC&GS Station Misale, in Bay St. Elaine. IP 113 BCPD and 4,008 M.c.f. daily, ⅞-in., 57.2°, perforations 11,514-30 ft. TD 14,650 ft. (New pay in Bay St. Elaine field.)

OKLAHOMA

Stephens County: Schafer Drilling Co. 1 Smith, 1 mile southeast of North Nellie Dist., C SW SW 5-1n-8w. IPF 288 BOPD Booth sand 3,592-3,602 ft., ¼-in., 39°; 504 BOPD Rowe sand 4,556-68 ft., ¼-in. choke, 40°. TD 5,805 ft. (Dual oil discovery.)

WEST TEXAS

Coke County: W. H. Black 1 Fred McCabe, 311-2-H&TC, 7 miles W Robert Lee. IPP 72 BOPD, 43°, GOR 212, Palo Pinto 5,462-70 ft. TD 7,025 ft.

Crockett County: Plymouth Oil Co. 1 University "O," 13-49-University Land, 9 miles S Big Lake. IP 170 BOPD, ⅞-in. 31.9°, GOR 938, TP 20 psi., San Andres 2,550 ft. TD 2,730 ft.

Gaines County: Felmont Oil Corp. 1 Oil Development Co., 107-H-D&W Sur., 13 miles NE Seminole. IP 1,521 BOPD, ½-in., TP 125 psi., GOR 14, 32°, top Mississippian pay 13,020 ft. TD 14,319 ft., elev. 3,219 ft.

Mitchell County: Sun Oil Co. and Union Oil Co. 1 Wallace, 34-12-H&TC, 16 miles SE Colorado City. IP 147 BOPD, ½-in., TP 55 psi., GOR 1190, 41°, Strawn 6,986-91 ft. TD 7,380 ft.

Upton County: J. C. Williamson and Bill Roden 1 Chancellor, 140-E-CCSD&RGNG, 10 miles E Crane. IP 405 BOPD, 16/64-in., TP 1,050 psi., GOR 997, 40°, Cisco limestone 8,795 ft. TD 9,010 ft.

WEST CENTRAL TEXAS

Coleman County: A. B. See 1 DePrangh, O. L. DePrangh Sur. 26, 5 miles NW Glencove. IPP 74 BOPD, 39°, GOR 650, Jennings sand 3,660 ft. TD 3,915 ft.

Fisher County: G. E. Kadane & Sons 1 Perry, 9-22-T&P, 2 miles SE Gannon. IP 202 BOPD, 18/64-in., TP 110, GOR 600, 41°, Canyon sand 5,256 ft. TD 7,010 ft.

Throckmorton County: Haynes B. Ownby Drilling Co. 2-B Reynolds, Sec. 286, BBB&C Sur., ½ mile SE Throckmorton. IP 288 BOPD, ¾-in., 40°, TP 300 psi., GOR 425, conglomerate 4,776 ft. TD 4,784 ft.

Sojourner Drilling Co. 2 Hendrick estate, J. Matthews Sur. 4, 19 miles NE Stamford. IPP 72 BOPD, 36°, GOR 186, Bluff Creek sand 1,471-79 ft. TD 3,304 ft.

NORTH TEXAS

Clay County: LaGorce Oil Co. 1-E Hapgood, Blk. 67, Marion CSL, 8 miles SW Ringgold. IP 140 BOPD, ¼-in., 44°, GOR 400, TP 125 psi., Strawn 5,016-33 ft. TD 5,084 ft.

SOUTHWEST TEXAS

Atascosa County: M. L. Wise and Thomas Brothers 1 Finch, P. Bervan Sur. 71. IP 310 BOPD, ¼-in., 41°, perforations 5,008-18 ft. (Navarro). TD 5,068 ft. (New field.)

Hidalgo County: H. R. Smith 1 McAllen et al, Las Mesteñas y la Abra Grant. IP 1,855 M.c.f. daily, 5/32-in., pressure 3,265 psi., GCR 31,800 cu. ft. per bbl., 48.1°, perforations 10,198-10,226 ft. TD 11,468 ft. (New pay in La Jara field.)

Willacy County: Pan American Production Co. 10 Lozana, San Juan de Carricitos Grant, Share 7. IP 103 BOPD, 5/32-in., 37.7°, Miocene 5,128-34 ft. (perforations). TD 8,337 ft. (New pay in Willimar field.)

TEXAS GULF COAST

Bee County: Union Producing Co. 1 Driscoll estate, T. Banuelos & Stepson Sur., A-2. IP 15,000 M.c.f. daily, open-flow potential, dry gas, perforations 4,271-78 ft. TD 5,516 ft. (New field.)

Brazoria County: Monsanto Chemical Co. 1 Tri, J.E.B. Austin Sur., A-17. IP 19,000 M.c.f. daily, open-flow potential, GCR 61,900 cu. ft. per bbl., 55.8°, perforations 9,556-73 ft. TD 9,802 ft. (New field—Manor Lake.)

Calhoun County: C. G. Glasscock et al 1 State, Tract 72, Hynes Bay (2 miles SW of Seadrift). IP 21,000 M.c.f. daily, open-flow potential, 41.4 BC per M.M.c.f., perforations 7,820-28 ft. (Frio). TD 8,304 ft. (New field.)

LEGAL

SEALED BIDS will be received until November 17, 2:00 P. M. Mountain Standard Time, and opened at that time in the office of the Superintendent, Fort Belknap Consolidated Agency, Harlem, Montana, for the leasing of 13,247.33 acres of Tribal land and 12,826.23 acres of allotted Indian land located in Townships 31 and 32 North, and Ranges 22 and 23 East, Principal Meridian, Montana, County of Blaine, Montana for oil and gas mining purposes. For further detailed information and a list of lands advertised call or write: Darrell Fleming, Supt. Fort Belknap Consolidated Agency, Harlem, Montana.

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P. O. Box 6326 DALLAS, TEXAS

PERSONALS

Barton Is Pioneer

Lion-Monsanto union grows from petrochemical vision

DURING the dark days of the '20s and '30s, there were times when Col. T. H. Barton's fledgling oil operations were tottering on the brink of bankruptcy.

But the present-day observer will find little resemblance between the colonel's maiden enterprises and Lion Oil Co., which flowed into a model of integrated efficiency under his imaginative direction.

It is a $150 million concern that Col. Barton has consolidated with Monsanto Chemical Co. in a precedent-shattering merger involving the first absorption of an oil company by a chemical concern.

The merger marks the end of one era and the beginning of another for the big, energetic board chairman and the company he built from a shoestring operation beginning on the eve of the Great Depression.

Barton, now a member of the Monsanto board, was 74 September 20. Freed of the chief executive officer's duties with Lion, he will have more time to enjoy the fruits of his 35 years' labor in the industry.

Thomas Harry Barton was born near Marlin, in Falls County, Texas, the son of a saddlery-store owner, T. K. Barton, who was the first white child born in the county.

First wildcat . . . His first oil venture came after World War I, during which he rose to the rank of colonel in the Army. His start was in keeping with the finest traditions of wildcatting—he went broke, spending his last $400 to shoot a well near Breckenridge, Tex., that turned out to be a dry hole.

The discovery of oil at El Dorado, Ark., solved his problem of where to turn next. Forty-eight hours after the strike was announced on January 12, 1921, he arrived in the wild-eyed boom town and stayed to see it prosper into a thriving city of 25,000 with his own company as its cornerstone.

By 1928 he was the leading oil operator in the area. That year he purchased control of Lion Oil Refining Co. (changed to Lion Oil Co. in 1945), and became president on January 1, 1929.

At that time the company had only one bulk plant, two service stations, a few working leases, a 10,000-bbl. refinery at El Dorado, and 3,600 bbl. of oil production a day. One year later, Barton had expanded the market outlets to 110, the El Dorado plant was enlarged, and oil production had increased to 12,000 bbl. daily.

When the depression struck, Barton had to fight for the company's life. His Shuler field discovery, a major oil development nationally, bailed Lion out of a desperate situation and put it in the black once more.

The company's biggest strike came in 1949—prolific Diamond M field, in Scurry County, Texas—and it doubled Lion's known oil reserves.

Petrochemical pioneer . . . Barton early saw the tremendous possibilities of petrochemicals, and during World War II convinced the Government that the nitrogen needed for explosives could be produced from natural gas.

At his urging, the Government built an ammonia plant at El Dorado. Lion leased the plant after the war, and bought it later, marking the company's turn to chemicals. By 1954 chemicals accounted for more than half its earnings and investment.

While rising to the top in the oil business, Barton did not neglect his community, state, or the industry at large. Operating on the philosophy that 10 per cent of his time should be devoted to community service, he worked as effectively in this field as in oil.

He was honored as the outstanding citizen of El Dorado in 1937 and of Arkansas in 1942. He holds honorary doctorates of law from four colleges and universities, and has received numerous other awards. He founded the Arkansas Livestock Show Association and is credited with helping his state build a major livestock industry through promotion of purebred cattle and hogs.

He is a trustee of George Peabody College for Teachers, Nashville, Tenn.; president and director, The Barton Foundation; trustee, First Methodist Church, El Dorado; a member of the board and executive committee, American Petroleum Institute; and member, the National Petroleum Council. He has numerous other positions in industry and civic organizations, as well as other financial interests.

Col. and Mrs. Barton have two sons, Clark N., a vice president of Lion, and T. K. Barton, who formerly published the Arkansas farmer magazine.

W. A. Reaman has been transferred from head of the refinery department of International Petroleum Co., Ltd., at Talara, Peru, to become assistant manufacturing adviser at Coral Gables, Fla. He joined International in 1948 after serving 11 years with a subsidiary, Tropical Oil Co. He has been head of the refinery department since 1952. **G. M. Stedwill,** chief chemist at Talara, has been named to succeed him. Stedwill joined Tropical in 1938. He transferred to International in 1947 and was named chief chemist in 1952.

William B. Borst has been named coordinator of construction and refining by Ashland Oil & Refining Co. Borst had been serving as superintendent of Ashland refinery at Canton, Ohio. Borst has been at the Canton refinery since 1936, when he started as a chemist with Alco Refining Co. He became assistant superintendent in 1937, when the plant was taken over by Allied Oil Co., now an Ashland subsidiary.

E. B. Granville, formerly associated with British-American Oil Producing Co., has joined Frontier Refining Co., of Denver, as production engineer.

Dilmas V. Fitz, former assistant general superintendent of the Petro-Tex Chemical Corp.'s butadiene plant at Houston, has been promoted to general superintendent. **H. A. Harrison** has been promoted to production superintendent from process superintendent. He will also perform the duties of assistant general superintendent. **C. Herbert Sloan** has been promoted from administrative assistant to succeed Harrison. **Walter A. Myrick, III,** former senior chemical engineer, has been named administrative assistant.

PERSONALS

Dr. E. O. Hook, formerly with American Cyanamid Co., has joined the research staff of Standard Oil Co. (Ohio) as coordinator of the mobile power lubricants and mobile power fuels process sections at Sohio's research laboratory. **Dr. W. S. McClenahan,** formerly with the Mellon Institute in Pittsburgh, has been named coordinator for the petrochemicals industrial products and basic research sections in the lab. Promotions made by the chemical and research division of Sohio include **Dr. Harry M. Stine,** named administrative supervisor in the section; **Dr. S. M. Darling,** advanced to section supervisor in the mobile power lubricants section; **Dr. Frank Veatch,** made section supervisor in the petrochemical section; **Dr. A. L. Jones,** promoted to section supervisor in the basic research section; **Dr. H. A. Strecker,** named section leader in the mobile power fuels process section; and **H. A. Hardman,** advanced to senior research associate in the industrial products section.

Alton E. Perryman, driller with Ohio Oil Co., has been transferred from Haynesville, La., to Wiggins, Miss.

W. Edward Lee, general manager and principal owner of Continental Drilling Co., Ltd., has moved his headquarters from San Antonio to Midland, Tex., in conjunction with the company's relocation there.

Haskell Davis has been named superintendent of a new district office opened at Abilene, Tex., by King-Phillips, Inc., a recently organized drilling contracting company headquartered at Fort Worth.

John S. Hegwer, former petroleum engineer with Ohio Oil Co. at Sidney, Neb., has resigned to join the engineering department of Mobil Producing Co. at Billings, Mont.

Robert J. Wittwer, former production engineer with Carter Oil Co. at Purcell, Okla., has been promoted to district engineer and transferred to Magnolia, Ark.

William M. Broderick has rejoined Anderson-Prichard Oil Corp. as manager of the company's West Texas division exploration department at Midland, Tex. He replaces **Roy Harris,** who resigned to enter business as an independent operator and consulting geologist. Broderick joined Anderson-Prichard in 1947 at Wichita as district manager there. He previously had served for 3 years with The Texas Co. at Wichita. He resigned from Anderson-Prichard in 1952 to become an independent.

E. HAMRIC

Edward Hamric, staff engineer for the pipeline department of Texas Gas Transmission Corp. for the past 4 years, has been named assistant to the superintendent. Hamric joined Texas Gas as an engineer in 1948. He was assistant to the pipeline division 1 superintendent at Memphis before becoming staff engineer for the pipeline department. In his new position, Hamric will assist **W. A. Johnson, Jr.,** the company superintendent, in all phases of the operations of the 3,000-mile system.

Earl L. Spieles has been promoted to assistant division petroleum engineer for the Casper, Wyo., division of Ohio Oil Co. Spieles, who was transferred from Casper to the Lovell, Wyo., district in 1953, joined Ohio in 1948.

Henry Carter Rea, consulting geologist, has returned to Denver after doing geological work in Italy for the past 6 years.

Bert Bock, former president of Trans Era Petroleum, Inc., has resigned to form Osage Oil & Gas Co., Inc., of Wichita.

Christy Payne, Jr., vice president of Peoples Natural Gas Co., has been named chairman of the American Gas Association's general promotional planning committee for the 1955-56 term.

H. H. Charles has been appointed technical assistant to the exploration director of Phillips Petroleum Co.'s land and geological department. **R. O. Dunbar** has been named to succeed him as assistant regional manager and regional geologist of the firm's Northwest region.

Dr. B. R. Banerjee has been advanced to group leader of the diffraction group in the physical metallurgy section of the materials division of Standard Oil Co.'s (Ind.) engineering research department. He joined the company as a research engineer in 1951. He has been an assistant project engineer since 1953.

John O. Bower has been named vice president and manager of Colombian Petroleum Co. and South American Gulf Oil Co., with headquarters in Cucuta, Colombia. Bower succeeds **C. O. Isakson,** who has been appointed management consultant until he retires in April 1956. Bower, who joined The Texas Co. in Colombia in 1927 as a geologist, has been manager of the Texas Petroleum Co. at Bogota, Colombia, since 1940. Isakson has spent more than 30 years with the oil industry in Mexico, Panama, Peru, Venevuela, Argentina, and Colombia. He became vice president and general manager of the Colombian companies in 1942. Colpet and Texas Petroleum are owned jointly by The Texas Co. and Socony Mobil Oil Co., Inc.

S. H. Letteer has been named superintendent of Gulf Oil Corp.'s newly formed zone production office in Denver. Letteer, who joined Gulf in 1926, had been serving as assistant zone production superintendent of the Kansas, Eastern and Rocky Mountain zone, with headquarters in Wichita. **W. E. Bauman,** zone development engineer at Oklahoma City, has been transferred to the Denver office as zone petroleum engineer.

F. L. Hartley, general manager of Union Oil Co.'s research department, and **A. J. Sullivan,** engineer with Standard Oil Co. of California, were awarded the meritorious service awards of the California Natural Gasoline Association at its recent meeting in Los Angeles. The awards, restricted to engineers under 42 years of age, were presented by **Grove Lawrence** of Southern California Gas Co.

Dean H. Mitchell, president of Northern Indiana Public Service Co. of Hammond, Ind., was elected president of the American Gas Association at its thirty-seventh annual convention in Los Angeles. Other officers of the association for the coming year are **C. H. Zachry,** president of Southern Union Gas Co., Dallas, first vice president; **A. W. Conover,** president of Equitable Gas Co., Pittsburgh, second vice president; and **Vincent T. Miles,** treasurer, Long Island Lighting Co., Mineola, N. Y., treasurer. Directors elected for 2-year terms are **M. A. Abernathy,** vice president, United Gas Pipe Line Co., Shreveport; **P. E. Beckman,** vice president, Pacific Gas & Electric Co., San Francisco; **R. E. Crawford,** president, Minnesota Valley Natural Gas Co., St. Peter, Minn.; **Lyle**

PERSONALS

C. Harvey, senior vice president, Carrier Corp., Syracuse; **John E. Heyke, Jr.,** president, Brooklyn Union Gas Co., Brooklyn; **D. E. Karn,** president, Consumers Power Co., Jackson, Mich.; **Wister H. Ligon,** president, Nashville Gas Co., Nashville; **Chester L. May,** senior vice president, Lone Star Gas Co., Dallas; **Robert W. Otto,** president, Laclede Gas Co., St. Louis; **F. T. Parks,** vice president, Public Service Co., of Colorado, Denver; **J. C. Peterson,** president, Manufacturers Light & Heat Co., Pittsburgh; **W. F. Rockwell, Jr.,** president, United Gas Improvement Co., Philadelphia; **J. Theodore Wolfe,** executive vice president, Baltimore Gas & Electric Co., Baltimore; and **D. K. Yorath,** general manager, Northwestern Utilities, Ltd., Edmonton.

R. M. Lilly has been promoted by Humble Oil & Refining Co. to production superintendent and transferred to Farmington, N. M. He had been serving as assistant district production superintendent at Hobbs, N. M. **Art Janes** has been named district geologist of the new Farmington district, and **Earl D. Wolcott** has been named toolpusher. The new office will handle production operations in the Four Corners area.

Wesley D'Ewart, of Montana, has been sworn in as assistant secretary of the interior for public land management, succeeding **Orme Lewis,** who resigned September 15. D'Ewart is a former member of Congress, where he served on the House interior committee.

D. J. Stark has been named plant manager of Escambia Bay Chemical Corp., which is building a new petrochemical plant at Pensacola, Fla. Stark had been serving as manager of National Petrochemicals Corp.'s plant at Tuscola, Ill., before joining Escambia.

G. R. L. Shepherd has been promoted to section head in the research and development division of Humble Oil & Refining Co.'s Baytown, Tex., refinery. He will head the section responsible for research in the fields of alkylation, polymerization, hydrogenation, and other related processes. **C. M. Floyd** has been promoted to senior research chemical engineer. He will study the performance of lubricants in various applications.

John L. Creigh has been named drilling engineer and assistant to the division manager of West Texas division by Delta Gulf Drilling Co. **Forrest J. Allen** has been named drilling engineer by the firm for its Gulf Coast division. **W. W. Stevenson** has been named drilling engineer by Perforaciones Guarico, C.A., and Perforaciones Delta, C.A., Venezuelan subsidiaries of Delta Drilling. **James I. Morris** has been appointed office manager for the two firms.

H. R. Bolton has been elected president of Hugoton Plains Gas & Oil Co. He succeeds **C. A. Houy,** who recently resigned. Bolton is vice president of exploration and production of Crescent Corp. **N. K. Anderson,** director of research and development of Crescent, was named vice president of Hugoton Plains.

E. Lawrence Morton has joined the staff of Esso Research Laboratories at Baton Rouge as a chemical engineer.

Robert C. Hills has been elected executive vice president and director of Freeport Sulphur Co. Hills joined Freeport in 1934 as an assistant chemist and was elected a vice president in 1950.

Norman R. Wyckoff has been named superintendent of Southern Counties Gas Co.'s Texas pipeline division. He succeeds **E. A. Wallace,** who has resigned.

Dr. James H. Gardner has been appointed technical assistant to the director of research of the National Research Corp. Prior to his appointment, Dr. Gardner was assistant director of the petrochemical department. Before he joined N.R.C., he was employed as a technologist in Shell Oil Co.'s Houston refinery.

Paul E. Schauer has been named to head the reservoir engineering for Carter Oil Co. Schauer has been serving as a petroleum engineer in Illinois basin operations for Carter since he joined the firm in 1948. Other changes made by Carter are **Milton E. Fox,** transferred from the petroleum engineering section in Tulsa to become district engineer at Purcell, Okla.; **Reginald D. Orr,** district engineer at Purcell, transferred to Shreveport as staff engineer in the southern division office; **George H. Link,** assistant superintendent of the Carmi, Ill., district, named staff engineer at Mattoon, Ill.; **John L. Dailey,** district engineer at Carmi, named assistant district superintendent there; **Jack K. Lytle,** transferred from Oklahoma City to Carmi as district engineer; and **Kenneth H. Larsen,** of Tulsa, who has replaced Fox in the petroleum engineering section at Tulsa.

John G. Montfort has resigned as district superintendent of Mid-Valley Pipeline Co., of Longview, Tex., to join Southern Pacific Pipe Line Co., of Los Angeles, in the same capacity. **William L. Dunlap, Jr.,** has been promoted by Mid-Valley to district superintendent at Oxford, Miss., to replace Montfort. Dunlap had been pump-station foreman at Mayersville, Miss. Before he joined Mid-Valley, he had worked for Sun Pipe Line Co. as assistant main-line engineer, main-line engineer, and station engineer in East Texas.

James A. Waters, who recently retired as chief paleontologist of Sun Oil Co. at Dallas, has opened consulting offices in Corsicana, Tex. Waters is a former president of the Society of Economic Paleontologists and Mineralogists and the Cushman Foundation for Formaminiferal Research.

N. W. Taylor has been named division geologist of the Canadian division of Honolulu Oil Corp. **P. E. McGovney** is Canadian division manager of the firm.

DEATHS

Russell G. Sullivan, manager of Sullivan Torpedo Co., Oklahoma City, was killed October 15 when 100 qt. of nitroglycerin exploded prematurely at a well near Wilson, Okla. Two of Sullivan's workers, **Harold E. Brill,** 34, and **William G. Chandler,** 25, also were killed in the explosion.

Nelson Shorts, 68, of Ashland, Ohio, died recently on an oil lease in Ashland County. Shorts had been in the oil business in Ohio and Pennsylvania for more than 20 years.

Marcus Todhunter Kendall, 61, former chief chemist of The Texas Co., died recently at his home in Long Beach.

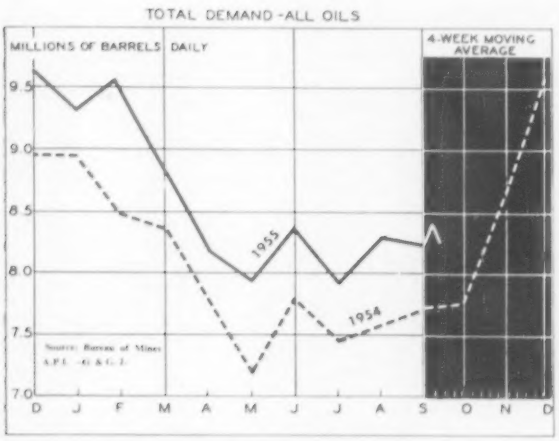
Herman Gregg, 54, of Forsan, Tex., superintendent for Plymouth Oil Co., died October 13 in Big Spring, Tex.

George Waltershausen, retired general superintendent of Deep Rock Oil Co.'s Cushing, Okla., refinery, died October 15 in Cushing. Waltershausen came to Cushing in 1917 when the plant was under construction. Earlier in his oil career, Waltershausen was associated with Universal Oil Products Co. during some of its first work on refinery technical developments.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,739,725	UP	32,150	UP	585,169
Crude stocks	254,986,000	UP	188,000	DOWN	18,173,000
Completions	1,149	UP	39	UP	131
Refinery runs	7,357,000	UP	166,000	UP	592,000
Gasoline stocks	150,480,000	DOWN	526,000	DOWN	196,000
Distillate stocks	148,849,000	UP	3,251,000	UP	15,596,000
Residual stocks	47,288,000	UP	447,000	DOWN	8,896,000
Four-product stocks	383,905,000	UP	3,925,000	UP	4,996,000
Total imports	1,003,100	DOWN	140,200	UP	136,900



High Gasoline Demands and Reduced Production Make Firm Markets

GASOLINE markets on the Gulf Coast and in the Mid-Continent and North Central areas have been very firm for the past few weeks. Many of the gasoline suppliers in these districts have given much credit to decreased supply following the fire at the Whiting refinery of Standard Oil Co. (Ind.) late in August.

A comparison of the refinery data from weekly reports shows that continuing high demand may have been as much a factor as decreased production.

The Whiting fire was on August 27. For the 5-week period ended August 26, gasoline production at refineries in Districts 2 and 3 averaged 2,617,000 bbl. daily. For the 6-week period from August 26 to October 7, gasoline production for these same districts averaged 2,556,000 bbl. daily. The reduction, amounting to only 61,000 bbl. daily, is small considering the fact that Standard of Indiana's plant was down completely for a little more than 3 weeks of the 6-week period and was operating at only about half capacity for the other 3 weeks.

The Whiting refinery has a rated capacity of 220,000 bbl. daily and is in a district where summer gasoline yields average at least 50 per cent of the crude runs. The over-all gasoline-production comparison for Districts 2 and 3 also must take into consideration the loss of gasoline production in District 3 caused by the strike at Republic Oil Refining Co.'s plant in Texas City. Since this refinery was down from August 10 until early in the second week of October, part of the drop in gasoline production during September can be charged against the Gulf Coast district.

Gasoline demand at refineries in Districts 2 and 3 averaged 2,650,000 bbl. daily for the 5-week period ended August 26. This total was only about 25,000 bbl. daily more than the average for the 6-week period ended October 7. A decrease of only 25,000 bbl. daily from midsummer to September is abnormal, but the small drop is further proof of continuing high demands for gasoline this year.

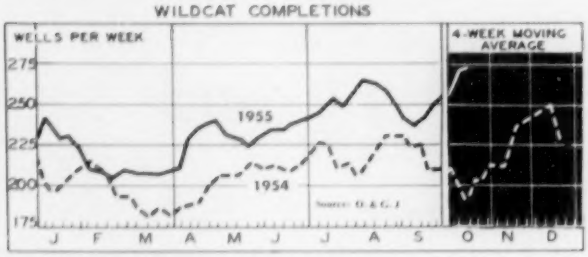
The combination of high demand and reduced production has held gasoline stocks at or below last year's levels. The strength shown by gasoline markets on the Gulf Coast is proof that the gasoline price wars along the upper part of the East Coast have not been due to any big oversupply of this product.

Reductions in tank-wagon prices for gasoline in New Jersey, Massachusetts, and Connecticut do not give much promise for an early solution for these price wars. Sun Oil Co. announced a reduction in tank-wagon price for New Jersey dealers, amounting to 1.5 cents a gallon. This brings the posted price for this state to 13.5 cents plus taxes. Other marketers announced reductions.

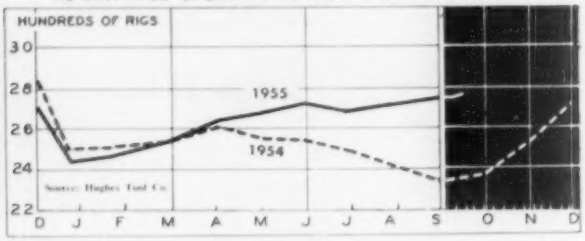
Higher fuel prices on West Coast . . . Standard Oil Co. of California announced an increase in prices paid for heavy crude and higher quotations for residual fuel, effective October 17. The maximum crude increase was 10 cents a barrel for 14° gravity. The raise was graduated downward to no increase for 26° gravity or lighter. Bunker fuel was raised 15 cents a barrel and No. 5 was moved up 20 cents.

The remaining buyers of crude in the Illinois basin have raised flat prices to $3.00 a barrel. Last week a few were still quoting $2.90.

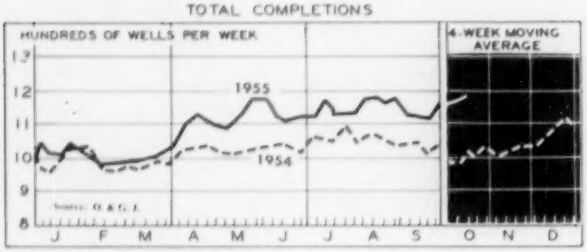
WILDCAT COMPLETIONS



ROTARY RIGS OPERATING IN THE UNITED STATES



TOTAL COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	10-17-55	Change from 10-10-55	Change from 10-18-54
Gulf Coast	584	—26	61
N. and W. Texas-New Mexico	920	22	186
Arkansas-N. Louisiana-E. Texas	176	5	5
Oklahoma	340	22	40
Kansas-S. Nebraska	193	10	31
Illinois-Eastern	130	— 2	—12
Rocky Mountain	282	—17	32
Pacific Coast	143	1	15
Total United States	2,768	15	358
Western Canada	211	19	60

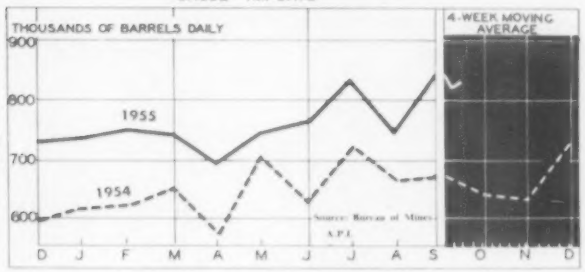
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED OCTOBER 15, 1955

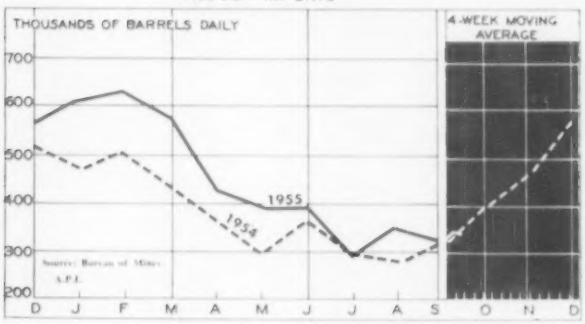
	Total of all wells: Comp.	Oil	Gas	Dry	Footage	Cum. 1955	Cum. 1954	Wildcat completions and discoveries: Oil	Dist.	Gas	Dry	Total	Cumulative total, 1955: Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	1	1	0	0	11,517	63	85	1	0	0	0	1	1	0	0	60	61
Arkansas	17	6	1	10	61,113	632	489	3	0	1	2	6	31	1	4	136	172
California	63	42	2	*19	294,007	1,945	1,874	3	0	0	13	16	37	0	11	342	390
Colorado	33	6	3	24	171,167	1,188	1,037	2	0	0	20	22	37	0	22	594	653
Illinois	82	35	1	46	187,121	3,063	2,188	0	0	0	11	11	51	0	4	437	492
Indiana	8	4	0	4	16,163	576	642	0	0	0	1	1	11	0	0	221	232
Kansas	86	37	7	42	326,247	3,960	3,572	3	0	1	13	17	113	1	30	651	795
Kentucky	45	23	1	21	56,574	1,223	882	2	0	0	9	11	45	0	9	249	303
Louisiana	98	61	5	32	619,503	3,159	2,716	2	2	1	9	14	95	65	25	352	537
North	53	37	2	14	148,689	1,641	1,485	0	0	0	2	2	22	6	4	145	177
South	45	24	3	18	470,814	1,518	1,231	2	2	1	7	12	73	59	21	207	360
Michigan	15	6	1	8	48,844	426	443	1	0	0	6	7	9	0	1	167	177
Mississippi	5	0	0	5	30,862	352	319	0	0	0	2	2	14	0	0	123	137
Montana	7	3	0	4	37,393	298	249	0	0	0	2	2	10	0	1	114	125
Nebraska	21	5	0	16	122,709	678	341	0	0	0	9	9	36	0	1	277	314
New Mexico	30	12	15	3	113,920	1,332	862	0	0	0	0	0	32	2	9	93	136
Northwest	14	0	14	0	38,963	446	313	0	0	0	0	0	5	1	9	27	42
Southeast	16	12	1	3	74,957	886	549	0	0	0	0	0	27	1	0	66	94
North Dakota	5	3	0	2	27,337	202	240	0	0	0	2	2	5	0	0	50	55
Ohio	32	15	4	†13	66,000	956	903	0	0	1	0	1	3	0	7	16	26
Oklahoma	140	83	3	‡54	483,930	6,705	7,099	3	0	0	10	13	118	15	24	529	686
Pennsylvania-New York	22	8	6	§8	36,349	1,208	1,823	0	0	0	0	0	0	0	7	10	17
Texas	396	239	12	145	1,705,917	15,947	14,606	14	4	1	88	107	625	86	106	3,280	4,097
Southwest (1 & 4)	79	50	3	26	300,593	2,456	2,058	2	2	0	19	23	96	29	32	618	775
Gulf Coast (2 & 3)	55	22	5	28	365,828	1,979	2,073	1	2	1	21	25	72	45	34	528	679
East (5 & 6)	20	11	2	7	79,606	777	777	0	0	0	3	3	21	4	8	257	290
North Central (7-B & 9)	137	63	1	73	450,081	6,005	5,502	6	0	0	37	43	308	0	13	1,302	1,623
West (7-C & 8)	86	77	0	9	446,657	3,901	3,419	5	0	0	8	13	124	1	10	549	684
Panhandle (10)	19	16	1	2	63,152	829	777	0	0	0	0	0	4	7	9	26	46
Utah	0	0	0	0	0	77	63	0	0	0	0	0	6	0	5	49	60
West Virginia	18	1	16	1	49,094	514	482	0	0	0	0	0	0	0	9	15	24
Wyoming	23	12	0	11	108,665	678	996	1	0	0	6	7	18	0	7	154	179
Miscellaneous (S. D.)	2	0	0	2	5,543	47	97	0	0	0	2	2	3	0	2	37	42
Total United States	**1,149**	602	77	470	4,579,975	45,229	42,008	35	6	5	205	**251**	1,300	170	284	7,956	9,710
Total previous week	1,110	581	64	465	4,546,452			29	4	10	254	297	1,265	164	279	7,751	9,459
Total October 16, 1954	1,018	533	75	410	4,252,779			30	1	8	183	222	1,139	112	313	7,089	8,662
Western Canada	46	32	1	13	178,914												

Service wells included: *1, †3, ‡13, §5.

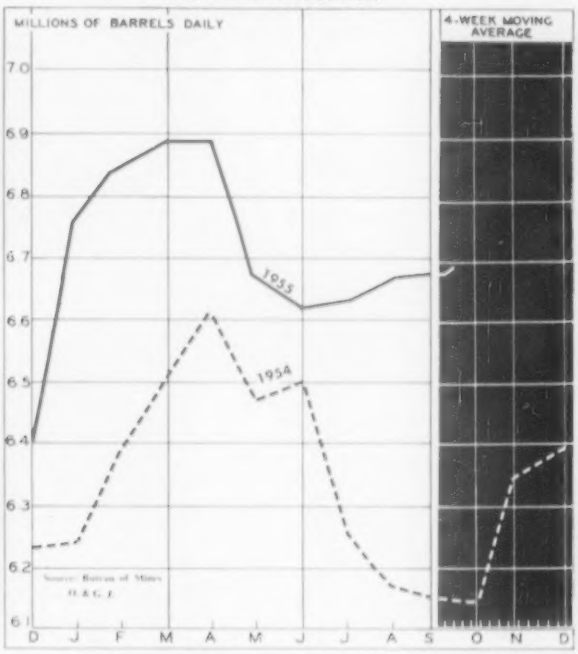
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION



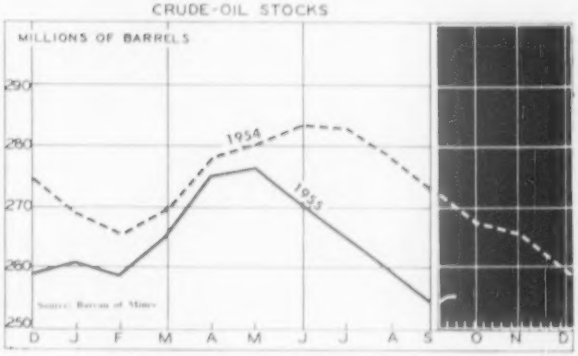
DAILY AVERAGE PRODUCTION FOR WEEK

	October 15			Oct. 8
	Crude oil	Lease condensate	Total	total
Alabama	4,000		4,000	4,100
Arkansas	73,500	400	73,900	73,100
California	976,700		976,700	977,500
Colorado	152,200		152,200	151,300
Eastern	50,800		50,800	50,800
Florida	1,375		1,375	1,375
Illinois	230,500		230,500	230,200
Indiana	30,200		30,200	29,900
Kansas	330,900		330,900	305,600
Kentucky	43,100		43,100	41,000
Louisiana	695,900	58,900	754,800	754,400
North	112,900	2,900	115,800	115,400
South	583,000	56,000	639,000	639,000
Michigan	31,600		31,600	30,600
Mississippi	102,900	4,400	107,300	107,300
Montana	41,600		41,600	42,300
Nebraska	30,200		30,200	28,100
New Mexico	225,900	2,500	228,400	228,500
North Dakota	26,100		26,100	24,600
Oklahoma	533,800		533,800	533,900
Texas	2,763,300	48,300	2,811,600	2,811,600
Dist. 1	50,000	475	50,475	50,475
Dist. 2	143,700	7,925	151,625	151,625
Dist. 3	408,000	23,025	431,025	431,025
Dist. 4	237,000	5,100	242,100	242,100
Dist. 5	51,000	400	51,400	51,400
Dist. 6	123,300	4,650	127,950	127,950
East Texas field	212,500		212,500	212,500
Dist. 7-B	149,000	50	149,050	149,050
Dist. 7-C	165,000	4,100	169,100	169,100
Dist. 8	928,800	2,000	930,800	930,800
Dist. 9	205,000	400	205,400	205,400
Dist. 10	90,000	175	90,175	90,175
Utah	6,500		6,500	6,500
Wyoming	273,900		273,900	274,700
Others	‡250		‡250	200
Total U. S.	6,625,225	114,500	**6,739,725**	6,707,575
Change from previous week			**up 32,150**	
Canada	†395,375		†395,375	†285,950

Total U. S. production, January 1-October 15 1,939,590,800 bbl.
Same period last year (crude plus cond.) *1,829,479,201 bbl.

*Includes 28,020,225 bbl. condensate. †Week ended previous Monday. †S. D. 100, Nev. 150.

CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OR ORIGIN*

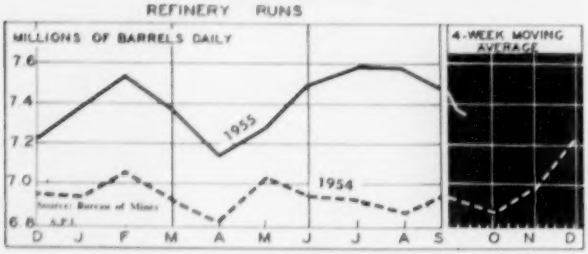
(Thousands of barrels)

	10-8-55	10-1-55	10-9-54
Pennsylvania Grade	3,278	3,259	3,031
Other Appalachian	1,970	1,970	1,681
Illinois, Indiana, Michigan	9,463	10,081	12,480
Nebraska, North Dakota	2,341	2,169	(‡)
Kansas	7,890	7,968	10,397
Oklahoma	20,903	20,629	25,769
Arkansas	2,667	2,602	3,327
Louisiana	16,341	16,199	15,704
North	2,734	2,600	2,513
South	13,607	13,599	13,191
Mississippi	3,180	3,268	2,969
New Mexico	7,409	7,218	8,683
Texas	119,823	119,657	127,486
East Texas proper	9,500	9,368	10,999
West Texas	56,742	56,742	56,668
Texas Gulf	24,267	24,372	25,747
Other Texas	29,314	29,175	34,072
Wyoming	14,062	14,669	12,856
Other Rocky Mountain	5,265	5,111	5,006
California	27,598	27,798	32,388
Foreign	†12,796	12,200	11,382
Total	254,986	254,798	273,159

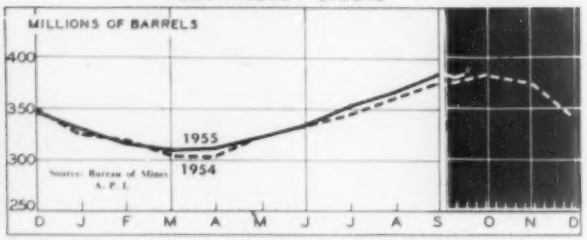
Bureau of Mines. †Includes 2,922,000 bbl. in California. ‡Included with Kansas.

CURRENT DATA ON RUNS AND PRODUCTION ARE 4-WEEK AVERAGES

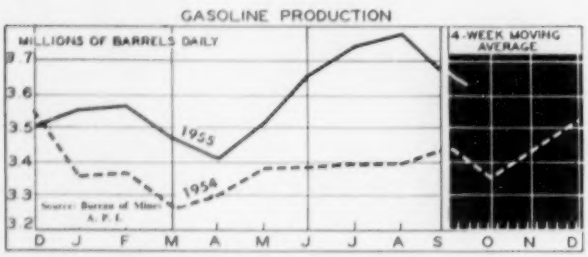
REFINERY RUNS



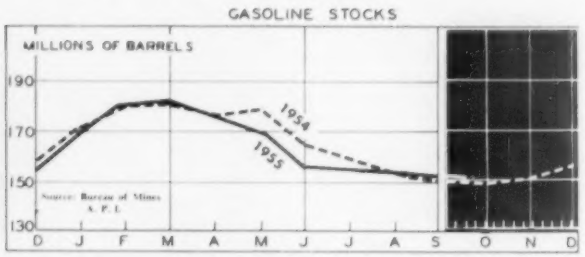
FOUR-PRODUCT STOCKS



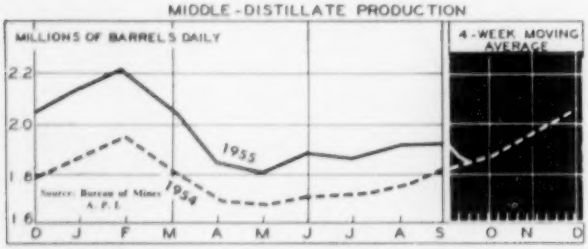
GASOLINE PRODUCTION



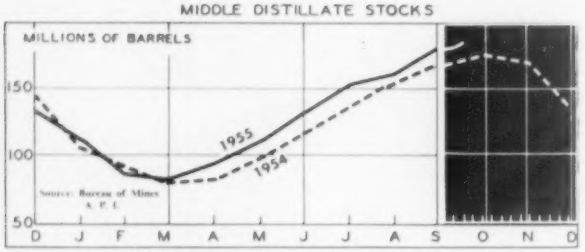
GASOLINE STOCKS



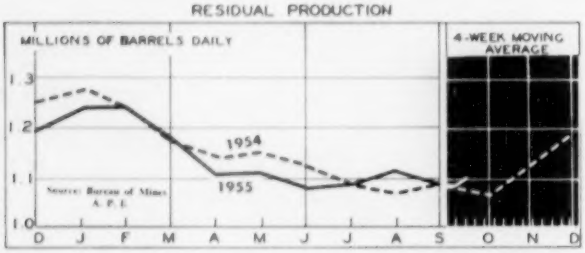
MIDDLE-DISTILLATE PRODUCTION



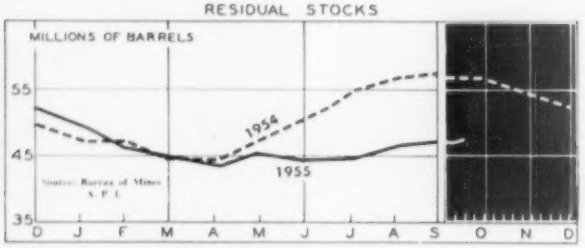
MIDDLE DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



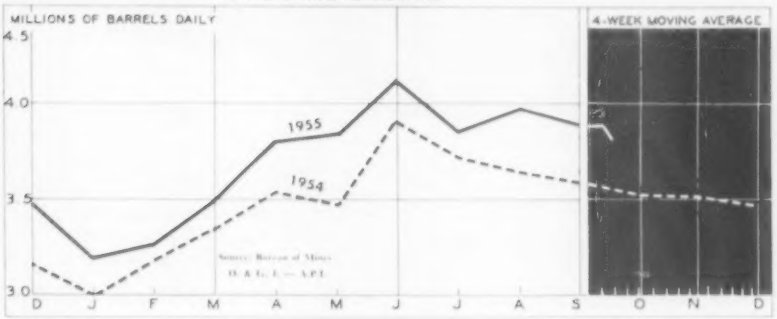
A.P.I. REFINERY REPORT, OCTOBER 14

(Thousands of barrels)

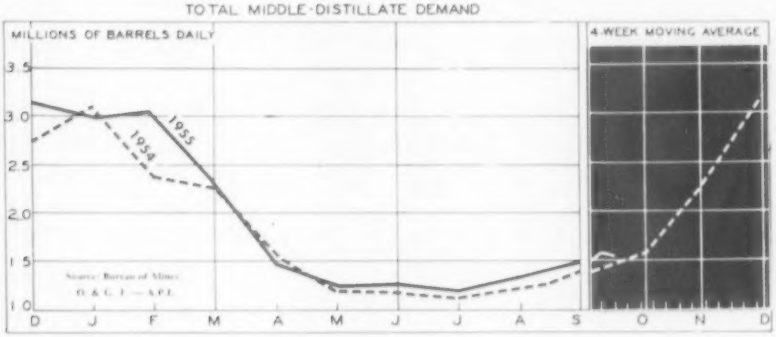
District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks†—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, October 1954—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	991	411.7	35.6	208.0	189.6	35,159	14,953	55,892	14,021	1,006	409.8	24.0	289.0	194.2
Appalachian:														
District 1	104	45.3	5.7	18.6	6.3	4,042	686	3,133	562	97	43.3	6.4	19.0	6.5
District 2	102	50.2	2.3	12.9	12.7	2,401	535	1,148	389	70	36.2	5.9	12.0	6.0
Ind., Ill., Ky.	1,309	727.4	49.7	244.7	166.3	30,675	9,448	29,232	5,045	1,223	660.7	74.1	234.7	148.2
Okla., Kans., Mo.	656	378.4	11.4	160.4	33.6	14,597	2,538	15,755	1,590	608	353.8	13.6	149.3	35.6
Inland Texas	238	190.7	5.9	52.0	22.1	5,709	491	2,855	1,307	232	175.6	8.6	43.5	21.6
Texas Gulf Coast	1,810	846.4	114.7	430.0	244.3	19,569	3,321	16,190	7,234	1,703	809.0	107.0	406.5	226.4
La. Gulf Coast	689	354.7	58.4	171.7	40.0	8,697	3,160	5,966	1,168	582	289.6	54.5	166.4	38.8
N. La. and Ark.	91	32.1	6.6	23.4	4.9	3,596	1,412	2,456	65	91	33.3	7.2	21.0	6.8
Rocky Mountain:														
New Mexico	23	10.6		4.3	2.9	216	4	77	42	14	9.0	0.7	2.1	2.4
Other Rocky Mtn.	238	111.0	0.4	59.9	34.8	5,035	374	2,786	924	214	102.0	3.2	52.7	32.3
California	1,106	493.6	3.4	170.8	333.8	20,784	306	13,359	14,941	994	439.2	4.3	148.6	347.2
Oct. 14, 1955	7,357	3,652.1	294.1	1,556.7	1,091.3	150,480	37,228	148,849	47,288	6,834	3,361.5	309.5	1,544.8	1,066.0
Oct. 7, 1955	7,191	3,621.9	295.1	1,495.1	1,101.7	151,006	36,355	145,598	47,021					
Oct. 15, 1954	6,765	3,299.3	325.4	1,451.9	1,075.9	150,676	38,796	133,253	56,184					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

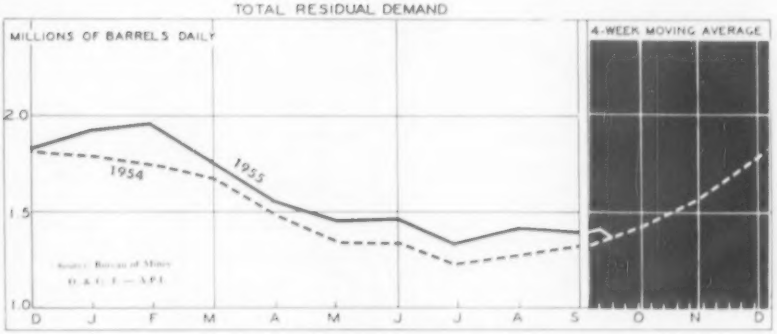
TOTAL GASOLINE DEMAND



TOTAL MIDDLE-DISTILLATE DEMAND



TOTAL RESIDUAL DEMAND



REPRESENTATIVE QUOTATIONS

Spot-market quotations of leading suppliers as of October 19, 1955. Prices are in cents per gallon, except for residual in dollars per barrel and wax in cents per pounds.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	11-11.25	11.5-12	10.5-10.75
Premium gasoline	12.25-12.5	13-13.75	12-12.25
42-44 w.w. kerosine	9.25-9.50	10.3	8.75-9.00
No. 2 straw fuel oil	8.25-8.50	9.55	8.5-8.75
No. 6 residual	$1.75-1.85	$2.55-2.75	$2.10-2.20

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5.5	5.0	5.25
Grade 18-55	6.6	6.1	6.35

LUBRICATING OILS
Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	19
200 vis., No. 3 neutral, 0-10 pp.	14.25

WAX
Mid-Continent

132-134 A.M.P.	6.0

• Gasoline markets continue firm in all supply areas except the northern part of the East Coast. Most marketers report moderate movement of distillate fuel with increases expected as soon as the high-demand areas get cooler weather. Heavy crude and residual prices moved up on the West Coast. Natural gasoline is strong in the Mid-Continent.

PRODUCTION AND DEMAND—MAJOR PRODUCTS
(Thousands of barrels daily)

	Refinery prod.	Total demand
Gasoline:		
Four weeks ended 10-14-55	3,635	3,796
July 1955	3,744	3,847
September 1954	3,391	3,649
October 1954	3,420	3,586
Middle distillate:		
Four weeks ended 10-14-55	1,841	1,530
July 1955	1,862	1,185
September 1954	1,755	1,197
October 1954	1,815	1,370
Residual fuel:		
Four weeks ended 10-14-55	1,102	1,389
July 1955	1,091	1,328
September 1954	1,069	1,258
October 1954	1,086	1,319

CRUDE PRICES
GRAVITY SCHEDULE

	Signal Hill, Calif.*	Okla-homa, Kansas	Gulf Coast Tex.†	West Tex.‡
14-14.9	$1.97			
15-15.9	2.03			
16-16.9	2.09			
17-17.9	2.15			
18-18.9	2.21			
19-19.9	2.27			
20-20.9	2.33	$2.50		$2.37
21-21.9	2.39	2.52		2.39
22-22.9	2.45	2.54		2.41
23-23.9	2.51	2.56		2.43
24-24.9	2.57	2.58	$2.91	2.45
25-25.9	2.63	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9		2.76	3.09	2.63
34-34.9		2.78	3.11	2.65
35-35.9		2.80	3.13	2.67
36-36.9		2.82	3.15	2.69
37-37.9		2.84	3.17	2.71
38-38.9		2.86	3.19	2.73
39-39.9		2.88	3.21	2.75
40 and above		2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast. ‡Sour. Includes New Mexico Permian.

Effective dates: California, October 17, 1955; east of California, June 15, 1953; Pennsylvania Grade, July 11, 1955.

FLAT CRUDE PRICES

Representative posted schedules per barrel

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	3.60
Middle District	3.47
Southwest Pennsylvania	3.18
West Virginia	3.07
Buckeye Grade	3.01
Zanesville Grade	2.82
Illinois Basin	3.00

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FOR SALE—National 3-A 6 Machine, excellent condition—with practically new D-13000 Caterpillar Diesel. Complete casing, steel and fishing tools. Mostly new. Box J-190, The Oil and Gas Journal, Tulsa, Oklahoma.

SLIM HOLE RIG—completely truck mounted and unitized—hydraulically raised mast—pull sixty foot stands—G.M. diesel powered—capacity 5000 feet slim hole—2500 feet 8⅝—complete inventory, pictures and price on request—Williams Drilling Co. 857 West 19th St., Costa Mesa, Calif.

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3—800# 20 MMCF Absorbers with scrubbers, etc.
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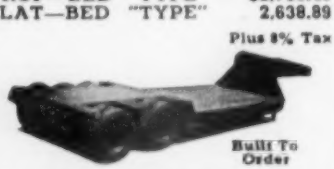
1—30" x 62' Depropanizer with Accumulator, Reboiler and Condenser.
1—Fluor "Counterflo" Induced Draft Cooling Tower Complete.

Other equipment, Instruments, Pumps, Pipe, Valves and Fittings necessary in Gasoline Plant Construction. Detailed Inventory Available upon request.

SOUTHERN PRODUCTION COMPANY, INC.,
P. O. Box 670, Phone FAnnin 8103, Fort Worth, Texas

NEW TRAILERS

DROP—BED "TYPE" $2,731.48
FLAT—BED "TYPE" 2,638.89
Plus 3% Tax



Built To Order

PASKO MACHINERY & STEEL
1721 CHICAGO DRIVE S. W.
GRAND RAPIDS, MICHIGAN

FOR SALE EQUIPMENT

FOR SALE—10,000 feet of new 2⅞" O.D. 10.40# External Upset, Internal Flush, API Seamless Drill Pipe, Grade E. Ends prepared for Reed Super-Shrink Tool Joints. Box H-896, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE—At Oil Hill, Kansas, 4—Cooper Type 80 Twin Engine Compressor Units, with 8½" x 20" Class A and 15½" x 20" Class C Compressor Cylinders. Also, 1—Type 80 Single DO. with 6½" and 10½" x 20" Tandem Compressor Cylinders. All with 18" x 20" Power Cylinders. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

LIQUIDATION

COMPRESSOR STATION

4—800 HP IR Type KVG Gas Engine Driven 2 Stage Compressors.

$50,000 New Spare Parts for Above.

2—IR Starting Air Compressors, Model 25C, Type 40, 285#, 67.6 cfm.

TOWERS - COLUMNS

1—6' x 58' x ½" Chrome-lined, 21 Trays.
1—6'6" x 65' x ⅝", 17 Chrome Decks, 9 Chrome Baffles.
1—3'6" x 49' x ⅞" Shell, 28 Trays, 180#.
1—30" x 34'10" x ¼" Shell, 18 Trays.

TANKS - VESSELS

6—1250, 1,000 Bbl. Welded and Bolted.
10—5-8' x 15', 10 x 20', 6 x 20', 5'3" x 38'6", (Chr. Lin. 90#).

HEAT EXCHANGERS

3—Kellogg 2400 sq. ft. Admiralty, 150# psi.
1—Efco Steel Tube 2000 sq. ft., 150# psi.
6—Efco 785 sq. ft. Adm. heat exchangers, 250#.
1—Griscom Russell Admiralty, 742 sq. ft., 150# psi.
3—Struthers-Wells Admiralty, 425 sq. ft., 150# psi.

ATMOSPHERIC HEAT EXCHANGERS

8—715 sq. ft., 850 psig, 304 Stls. St.
6—470 sq. ft., 850 psig., 304 Stls. St.
13—715 sq. ft., 125 psig, 304 Stls. St.
6—715 sq. ft. Admiralty 125 psig, 300° F.

MISCELLANEOUS

1—Lab Petrochem Isoflow Furnace 50,000 BTU/hr.
1—B.J. Hot Oil Pump 3" x 9", 14 stage, 325 gpm, 4620' head, 11-13 nickel chrome impeller, 400 HP st. turbine.
1—Goulds 4" Pump, 400 gpm at 1600' hd.

Partial List Only

WIRE! PHONE! WRITE!

BRILL EQUIPMENT COMPANY

4101 San Jacinto St., Houston 4, Texas, JA 6-1351
Or
2401 Third Ave., New York 51, N. Y., CYpress 2-5783

FOR SALE EQUIPMENT

FOR SALE—Our gasoline plant north of Arkansas City, Kansas. Complete details and price furnished upon request. Contact Patridge, Cities Service Oil, Bartlesville, Oklahoma.

GARDNER-DENVER two-stage gas compressor unitized unit powered by 250 H.P. Buda motor and all equipment, gauges and coolers necessary to operate. All in first class condition. Gulf Southwest Service Co., P. O. Box 1328, Shreveport, La. Telephone 2-8428.

FOR SALE

6000 ft. 8⅝"—28.35# No. 2 Grade, P.E. Used L. W. Line Pipe, located at Oklahoma City.

FORD CARMAN SUPPLY CO.
202 Tri-State Bldg., Tulsa, Okla.
Ph. LUther 5-1949.

FOR SALE:

Refinery equipment located at Winnsboro, Big Sandy, and Mt. Pleasant, Texas. New and used as follows: pumps, bubble towers, tanks, compressors, pipe stills, valves, fittings, control instruments, condenser tubes, still tubes, and still headers.

AMERICAN LIBERTY OIL COMPANY
Engineering Department,
Box 1011,
Mt. Pleasant, Texas

RECONDITIONED BLACK PIPE

8⅝" O.D. .322 wall 28.55 lbs. per foot—100,000 Feet.

12¾" O.D. .375 wall 49.56 lbs. per foot—35,000 feet.

20 foot random lengths lapweld.

Beveled ends ready for installation in gas, water, oil lines or structural purposes.

Complete inventories of all sizes black and galvanized pipe also available.

WRITE—WIRE—PHONE

Sonken-Galamba Corporation

2nd and Riverview (X-160)
Kansas City 19, Kansas
ATwater 9305

FOR SALE EQUIPMENT

FOR SALE: 18" x 21" and 20" x 23" modified cycloidal Roots Connersville Air pumps. Either vacuum or pressure; up to 11 psig differential pressure; range 2000-4000 cfm; machines little used; guaranteed mechanically good; roller bearings; late models; price dependent upon application and requirements. Refer all inquiries to Walter Gasser and Associates, P. O. Box 863, Pasadena, Texas.

GA 350 EMSCO rig complete with two D 17,000 Caterpillar diesel engines, Lee C Moore 126' mast, 7¼ x 14 G-D pump, Two QRC CIW 4,000# preventers & 5 x 10 G-D mud mixing auxiliary pump with Waukesha engine, good condition. Operating in area of Natchez, Mississippi; priced to principals for quick sale, subject to prior sale, with or less, 4" OD drill pipe. Wire or call Clinch Drilling Company, Jackson, Mississippi.

FOR SALE 100 tank cars 10,000 Gal. Cap. AB Brakes, Class III. 40 Ton Trucks. Darien Corp., 60 E. 42nd St., N. Y., N. Y.

FOR SALE

12" Line Pipe

(IMMEDIATE DELIVERY)

200,000 ft. 12¾" O.D. x .375 Wall, 49.56#, Lapweld, All Machine Cleaned, Straight, App. 20' SRL, Ends Beveled, Used Good Condition.

SUITABLE FOR

Oil, Water, or Gas Systems,
Water Well Casing, Irrigation Pipe,
Piling or Structural Use

Located: Kansas and Missouri

Large additional quantities same size available soon from present take up and reconditioning operations in Missouri.

Priced Attractively for Prompt Shipment

Humboldt-Chicago Pipe Line Project

125 W. 3rd St. Tulsa, Okla.
CHerry 2-9128 LUther 4-4229

FOR SALE

GASOLINE PLANT EQUIPMENT LOCATED IN LOUISIANA

1—36' x 48' x 14' Stefco Steel Building
3—225 H.P. Miller Gas Engines Directly connected to 17½" Compressor Cylinders.
5—#245 S.W. Gas Coolers.
1—8' x 10' Vertical Welded Scrubber Tank.
1—72" Dia. x 48' Tulsa Type Absorber #1880 W/22 Trays.
1—6' x 20' Welded and Riveted Steel Horizontal Vent Tank.
4—9' x 10' Welded and Riveted Steel Horizontal Scrubber Tanks.
2—5" Dean Hill Cent. Pumps. Connected to 30 H.P. Westinghouse Motors.
1—36" x 49' 30 Tray Stabilizer. Welded Construction. Will Handle 60,000 Gals. Gasoline Per Day.
1—Type K24-300-2-200-250 Stabilizer Kettle.
1—200 H.P. Hope Gas Engine Direct Connected to 125 KW 480 Volt 3 Phase, 60 Cycle General Electric Generator.
Also Several Recording Regulators, Pumps, Compressors and Piping.

For Detailed Inventory, Write or Wire
SHELL OIL COMPANY,
Box 193, New Orleans, Louisiana
Attention, J. H. Cranfill.

FOR SALE EQUIPMENT

FOR SALE: 3 Type 80 Cooper Twin Gas Engine Driven Compressors rebuilt like new ready to go. Compressor Cylinders to suit. Write or phone W. S. Smith, 205 Thompson Bldg., Tulsa, Okla. LUther 2-5473

DRILLING RIG 5½ Keystone. Trailer type. Lines. Running condition, all necessary tools. An exceptional buy $2500.00. M J. Regan Pipe Co., Coffeyville, Kans.

SAVE MONEY
on
8" LINE PIPE
LAPWELD 8⅝" O.D. 28.55

Very good No. 1 grade, used pipe. Straight 20' single random lengths machine cleaned.
Choice of plain end or T&C. Ideal for oil, water and gas systems, 850 to 900 psi.
Pipe located in Illinois, with low barge, rail and water rates to any part of the world. Priced below market, selling at almost ½ cost of equivalent new pipe.
Will sell for cash or will finance meritorious propositions.

Brokers and agents protected

REDNEB PIPE CO.
P. O. Box 1798 Shreveport, La.
Phone 2-3276

PIPE 1/8" thru 30"

FASTER THAN FOSTER

TESTED & STRUCTURAL
Large Warehouse Stocks

- SPIRAL WELD
- SEAMLESS
- ELECTRIC WELD
- LAP WELD
- BUTT WELD
- CONTINUOUS

RAILS - TRACK EQUIPMENT - PIPE - PILING

L B FOSTER Co.

PITTSBURGH 30 • NEW YORK 7 • CHICAGO 4
ATLANTA 8 • HOUSTON 2 • LOS ANGELES 5

FOR SALE

8" Line Pipe

IMMEDIATE DELIVERY

400,000 ft. 8⅝" O.D. x .322 Wall, 28.55#, Lapweld, All Machine Cleaned, Straight, App. 20' SRL, Ends Beveled, Used Good Condition.

SUITABLE FOR

Oil, Water, or Gas Systems,
Water Well Casing, Irrigation Pipe,
Piling or Structural Use

Located: Kansas and Missouri

Large additional quantities same size available soon from present take up and reconditioning operations in Missouri.

Priced Attractively for Prompt Shipment

Humboldt-Chicago Pipe Line Project

125 W. 3rd St. Tulsa, Okla.
CHerry 2-9128 LUther 4-4229

FOR SALE EQUIPMENT

EMSCO 250 RIG, complete with Emsco double mast. Excellent condition. 4,000-ft. practically new, 4½-in. drill pipe. Rig now running. Bargain. Phone FOrest 8-5886, 421 Meadows Bldg., Dallas, Tex.

SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment; from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply, Tulsa.

FOR SALE—One Ingersoll-Rand DR-600 gyro-flo rotary air compressor truck mounted. Excellent condition. Write P. O. Box 819, Longmont, Colo. Phone 1333.

TWO 330 H.P. USED Cooper-Bessemer GMX 6 TF packaged gas compressors. Excellent condition. Designed for suction pressure zero psi discharge 500 psi. Southwest Industries, Inc., Box 7773, Houston 7, Texas.

FINAL

REFINERY LIQUIDATION

POCATELLO, IDAHO

TOWERS
4'x59' 23 trays, 160 PSI.
7'6"x41'7" Reactor, 160 PSI.
4'6"x40' 13 trays, 180 PSI.
2'x47' 20 trays, 200 PSI.
2'x47' 20 trays, 375 PSI.
3'x49' 28 trays, 425 PSI.
2'x37' 16 trays, 250 PSI.
5'x36' Scrubber, 240 PSI.

FURNACES
Crude Oil, 8 million BTU/hour comb. oil & gas burners, chrome tubes (2).
Cracker, light oil, 10 million BTU/hour comb. oil & gas burners, chrome tubes.
Vacuum, 15 million BTU/hour comb. oil & gas burners, chrome tubes.

HEAT EXCHANGERS
Steel Tubes, 94 to 550 sq. ft. (5)
Adm. Tubes, 140 to 440 sq. ft. (7)

PUMPS
HOT OIL TRANSFER
CENTRIFUGAL

COMPRESSORS
170 to 300 CFM Elec. & Steam.
1406 SCFM Gas Driven.

LOADING RACKS
28 & 8 Car R.R., 3 & 2 Truck.

STEEL BUILDINGS
(11) from 150 sq. ft. to 2500 sq. ft.

BOILERS
3—153 HP 160 PSI Water Tube.
1—250 HP 150 PSI Stirling
2—4'x135' Steel Stacks

ETHYL BLENDING PLANT
Complete Unit.

METERS & CONTROLS
Quantity—All Types.

PIPE, VALVES & FITTINGS
½" to 12" Welded and Seamless.

STORAGE TANKS
(45) from 500 to 35,000 bbl. ALL WELDED.

WRITE FOR COMPLETE INVENTORY

Heat & Power Co., Inc.

60 East 42 Street, New York 17, N. Y., Murray Hill 7-5280
Pocatello, Idaho, Phone: Poc. 5490

NEW STEEL PIPE

	Wall	Wght	Appr. Length
10¾" O.D.	250	28 lb.	13,600 ft.
8⅝" O.D.	291	19.64 lbs.	10,000 ft.
16" O.D.	250	42 lbs.	8,200 ft.
26" O.D.	288	40' lengths	1,000 ft.
30" O.D.	344	40' lengths	600 ft.

If you require pipe of sizes write for inventory and other information Available for Immediate Shipment . . . Write, Wire or Phone

BROWN-STRAUSS CORPORATION

1546 Guinotte Phone HArrison 1000 Kansas City, Mo.

FOR SALE EQUIPMENT

THREE CAR Patterson Steel Company Tank Carloading Rack. Priced for quick sale. For full details write or call. South Texas Pipe & Supply Co., P. O. Box 3188. Phone TUlip 3-9337, Corpus Christi, Texas.

FOR SALE: Following used lapweld Plain End Used Line Pipe Located in Ohio. Subject to Prior Sale. Attractively priced 10,000 ft. 6⅝" O.D. x .250" Wall. 3,000 ft 8⅝" O.D. x .250" Wall. 19,800 ft. 8⅝" O.D. x .219 Wall. 2,500 ft. 8⅝" O.D. x .322" Wall 1,840 ft. 8⅝" O.D. x .344" Wall. 36,000 ft 10¾" O.D. x .365" Wall. 2,000 ft. 12¾" O.D. x .312" Wall. WIRE—WRITE—PHONE THE BUCKEYE SUPPLY COMPANY, 18 Harrison Street, Zanesville, Ohio. Phone—GLadstone 2-3641.

GLYCOL DEHYDRATION Unit complete. Designed capacity 60 million cubic feet at 700# pressure, 50° depression. 8—5½x20 compressor cylinders. J. C. McConnico, 810 Colcord Bldg., Okla. City, phone CEntral 2-6318.

SEISMOGRAPH CABLE TRUCK with special "Sewall" body using 5 cable handlers (Squirts) and 5 cable bins, mounted on 1952 Dodge Power Wagon. Excellent Condition. Texas Seismograph Company, Box 2069, Wichita Falls, Texas.

COMPLETE ROTARY RIG. Failing model 2500, trailer mounted, powered by GMC Diesels. 2500' 3½" F. H. drill pipe, 4 drill collars, dog house, fuel tank, water tank, light plant, hand tools, and GMC tandem truck. Contact M & G Drilling Co. 1102 East St. Iola, Kansas. Ph. 1979.

FAILING 1500 heavy duty drill with 4½x5 pump, automatic pulldown, and mounted on Ford Truck. Write P. O. Box 819, Longmont, Colo. Phone 1333.

CORE DRILLS, SPUDDERS, ROTARIES. New and used equipment. Everything in supplies. Fishing tools rented. Pressey & Son, Pueblo, Colo.

FOR SALE: Keystone Drilling Machine, tools, 5 to 12½ inch. G.M.C. truck winch and fifth wheel. Price $2,500. Leamon & Woolfolk, McLouth, Kansas.

LIGHT ROTARY RIG, hydraulic mast, Waukesha motor, Gardner-Denver pump with Hercules engine, all mounted 2½ ton 5x6 GMC, light plant, 600' drill pipe, reasonable. W. J. McMeans, Marietta, Oklahoma.

GAS COMPRESSORS. 50 to 400 hp up to 2000 psi. One, two, three or four stages. NEW and USED. FOR SALE OR RENT. Call M. C. Bolin, CHerry 2-6291, Box 868, Tulsa, Oklahoma.

FOR SALE at our Wichita gasoline plant, 12 10-ft. by 40-ft. riveted and welded gasoline-storage tanks, $750 each. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

FOR SALE at our Wichita gasoline plant, 11 33-in. O.D. by 43-ft. high welded absorbers filled with 3-in. triple-spiral tile, 450 lbs. working pressure. Also 14 30-in. O.D. by 41-ft. riveted absorbers with triple-spiral pipe, 400 lbs. test pressure. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

We Own and Offer For Sale At Very Attractive Prices—

CLASS III TANK CARS

6—8000 Gal. 3 Compartment Coiled
9—8000 Gal. 3 Compartment Non-Coiled
87—6000 Gal. Single Compartment Non-Coiled
246—8000 Gal. Single Compartment Non-Coiled

All in Interchange Condition

If you need Tank Cars don't miss this buying opportunity.

DON'T WAIT—
PHONE—WIRE—WRITE

HYMAN-MICHAELS COMPANY

108 North State St. Chicago 2, Ill.
Phone: DEarborn 2-5422

EQUIPMENT WANTED

WANT 3,500' to 4,500' Rotary Rig near new. Send inventory and asking price. D. D. Willett, P. O. Box 1246, Palmer, Alaska.

7¼ x 12 and 7¼ x 14 mud pumps with engine skid mounted. Box J-173, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: New and used bolted type steel tanks, all capacities, also pressure and regular storage tanks. A. Greenspon Pipe Co. Inc. 8890 Ladue Rd. St. Louis 24, Missouri.

HELP WANTED

PETROLEUM ENGINEERS—Want young engineers with up to four years experience in drilling, production or reservoir work for immediate employment in Rocky Mountain Area and other points. Salary commensurate with experience and training. Our employees have been advised of this employment offer. Box J-197, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANTS, Chemical Engineers, Mechanical Engineers, Geologists, Physics Graduates, female stenographers. Linguists desired. No fee. Oil Industry Employment Service, Box 2603, Tulsa, Okla.

AREA ENGINEERS

Several graduate engineers with minimum 5 years' experience supervising maintenance engineering functions in oil refining or producing facilities, power plants, heavy industrial installations, manufacturing plants or related operations. To establish technical supervision, procedures, maintenance operations and schedule routine and special work for major oil producing and refining operation with all supporting facilities; i.e., housing, feeding, recreation, etc.

Salary commensurate with background and experience. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 64

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

HELP WANTED

PETROLEUM ENGINEER, experienced all phases production including completions and rework. Excellent opportunity advancement. Detail education and experience. P. O. Box 1016, Tulsa.

PROJECT ENGINEERS
CHEMICAL AND MECHANICAL ENGINEERS

B.S. plus 5 years experience in Chemical and Refinery Units.

Work includes supervision, equipment selection, layout and design.

Send complete resume of background, experience and salary requirements to:

TELLEPSEN PETRO-CHEM CONSTRUCTORS
P. O. Box 2536 Houston, Texas

Refinery Superintendent

For independent refinery in Southwest Texas, with growing commercial business and military contracts. Should have 10 years experience in plant and laboratory operations, including jet fuel production and testing; also requires knowledge of tank truck operations.

Submit resume of experience along with availability and expected salary to

BOX J-162,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

GEOLOGIST

Independent oil company has opening for geologist with 2 to 3 years major company experience in Oklahoma. Good position for right party. In replying give past employment record, educational background, etc.

Box J-155, The Oil and Gas Journal,
Tulsa, Oklahoma

EQUIPMENT INSPECTORS

(Ages 25-32)

Career opportunities with a major integrated oil company operating in South America. Vacancies exist in refinery equipment inspection positions at levels requiring two to five years inspection experience. Candidates must be graduate engineers with a degree in engineering, preferably mechanical or metallurgical engineering. Salary, including bonus, $11,000 - $12,500, depending on qualifications and experience. Liberal employee benefits, home vacations with travel expenses and tax savings. Send complete resume of education, personal data and work experience. Interviews will be arranged for candidates whose resumes indicate potentiality. Replies held in strict confidence.

BOX 1221
DEPT. Q-21
NEW YORK 1, N. Y.

HELP WANTED

GEOPHYSICIST. A major contracting geophysical company has an opening for a geophysicist to be in charge of its foreign department. Must have 10 years experience, the majority in foreign service, a college education, and an ambition to make new acquaintances. Write details of age, education, experience, availability for travel, etc., to Box J-160, The Oil and Gas Journal, Tulsa, Oklahoma. Our employees know of this ad.

EXPERIENCED MAN over 60 years of age as Caretaker and Superintendent of compressor making gasoline out of gas. West Texas, comfortable living quarters. EMPIRE OIL OF NEW JERSEY, 2630 Republic National Bank Building, Dallas 1, Texas.

WANTED

GAS AND RESERVOIR ENGINEER
For Estimation of Gas Reserves

DRILLING ENGINEER
With Knowledge of Mud Problems and Drilling

PIPE LINE ENGINEER
Engineering Supervisor for Pipeline in Operation

For Work on De Mares Concession in Colombia. Only Graduate Engineers Considered.

BOX J-170,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

FOREIGN SERVICE
MAJOR OIL COMPANY

Petroleum Engineer

Degree and at least four years of reservoir engineering experience. Must be well grounded in practical production practices.

Engineer

Degree, two to four years practical experience drilling mud control.

Married status if desired—both jobs.

For Interview, Write

Box J-192,
The Oil and Gas Journal,
Tulsa, Oklahoma

CORROSION ENGINEER

Experienced in cathodic protection work on bare and coated lines. This is a permanent position and offers unusual opportunities to a well qualified man. A degree in engineering is required with a minimum of five-years experience in related work. Immediate location would be in Illinois or Indiana. All replies will be held in strict confidence. Send resume of education, experience, and salary requirements, also photograph to:

Sohio Pipe Line Company
Attn.: R. D. Draus,
Industrial Relations Manager
407 North Eighth Street
St. Louis, Missouri

HELP WANTED

SOUTH AMERICA. Major Oil Company. Our Fee paid. Mechanical, Petroleum, Civil and Chemical Engineers—Geologist (must be single)—All requiring Degree, experienced or inexperienced. Tool Pusher, three years experience. On all jobs age limit is 40. All information confidential. Contact CHAS. J. LOVELESS PERSONNEL SERVICE, 616 South Main, Tulsa, Oklahoma—GIbson 7-3193.

OPERATING SUPERVISOR—Small expanding company producing diversified industrial organic chemicals has opening for chemical engineering graduate with chemical plant operating experience. Unusual opening for man possessing individual initiative who is prepared to take charge of entire plant operations. Submit resume and salary requirement. Box J-186, The Oil and Gas Journal, Tulsa, Oklahoma.

Refinery Operators

Foreign Employment

With minimum 7 years' oil refining experience. Must have experience on process units such as crude distillation, thermal reforming, fluid catalytic cracking and reforming and thermal cracking. For refinery operation in Saudi-Arabia.

Write giving full particulars regarding personal history and work experience. Please include your telephone number.

Recruiting Supervisor, Box 85

ARABIAN AMERICAN OIL COMPANY
505 PARK AVE. NEW YORK 22, N. Y.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

WANTED—Landman experienced in contracts, titles, and leasing. Preferably one with major oil company background. For medium-sized independent. Box J-179, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Experienced Seismic Computer to train for Party Chief position. Write, giving full account of experience and education, Box J-174, The Oil and Gas Journal, Tulsa, Oklahoma.

COLLEGE GRADUATES in Chemical, Mechanical, Petroleum Engineering, with experience or without experience, are wanted for several openings at beginning and higher levels in the Los Angeles County Air Pollution Control District. Salaries begin at $489 and $608 month for 40-hour, 5-day week. Air Mail brief resume of education and experience to A. Zill, Los Angeles County Civil Service Commission, 501 N. Main, Los Angeles 12, Calif. Include telephone number. There will be no written examination. Employment interviews will be held in various parts of the United States. Offers of appointment can be made at that time.

WANTED—
Drilling Engineer

Foreign Drilling Operation

Oil well drilling contractor has immediate opening for drilling engineer in Brazil. Liberal salary and bonus.

Drilling and Exploration Company, Inc.
P. O. Box 2—Station "H"
LOS ANGELES 44, CALIFORNIA

PETROLEUM ENGINEERS

Graduate petroleum engineers with 3 to 5 years' experience wanted by MAJOR OIL COMPANY for work in the Mid-Continent and Gulf Coast areas. In reply, please give resume of experience and salary expected.

BOX J-194, THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

MECHANICAL ENGINEERS
(Ages 28-40)

Desired for career opportunities with a major integrated oil company operating in South America. Position vacancies exist for graduate mechanical engineers at levels requiring five to fifteen years of mechanical engineering experience. Activities include design, installation and modification of compressors, turbines, hoists, pressure vessels, automatic controls, air, gas, steam and water distribution systems, centrifugal pumps, etc. Excellent growth opportunities in an expanding organization. Salary, including bonus, $12,500 - $19,000, depending on qualifications and experience. Liberal employee benefits, home vacations with travel expenses and tax savings. Send complete resume of education, personal data and work experience. Interviews will be arranged for candidates whose resumes indicate potentiality. Replies held in strictest confidence.

BOX 1221
DEPT. T-21
NEW YORK 1, N. Y.

HELP WANTED

PETROLEUM ENGINEERS

(Ages 26-38)

Career opportunities for petroleum engineers with a major integrated oil company operating in South America. Position vacancies exist in reservoir and petroleum production engineering at levels requiring from five to ten years pertinent experience. Candidates must have a degree in petroleum, mechanical or chemical engineering. Excellent growth opportunities in an expanding organization. Salary, including bonus, $12,500 - $17,000, depending on qualifications and experience. Liberal employee benefits, home vacations with travel expenses and tax savings. Send complete resume of education, personal data and work experience. Interviews will be arranged for candidates whose resume indicate potentiality. Replies held in strictest confidence.

BOX 1221

DEPT. Y-21

NEW YORK 1, N. Y.

ENGINEER, PROCESS—For small southwest refinery should have some experience thermal cracking and catalytic treating—good opportunity young man—write fully experience, aslary. Replies confidential. Box J-175, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY SUPERINTENDENT WANTED

for refinery located in Middle West. 5000 barrel crude capacity, 2250 barrel Thermal Cracking, 1000 barrel Platforming, and 1500 barrel Naphtha Unit.

Box J-181, The Oil and Gas Journal. Tulsa, Oklahoma.

PETROLEUM ENGINEERS

Experienced graduate engineers for immediate openings in Saudi Arabia and New York City. For engineering work in development, production, drilling, process, and oil and gas engineering on primary and secondary recovery problems.

SUPERVISORY PETROLEUM ENGINEER

For responsible staff position in Saudi Arabia, directing the work of experienced engineers making Petroleum Reservoir Studies. Advise management on Petroleum Reservoir Engineering problems.

Salaries commensurate with training and experience. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 79

ARABIAN-AMERICAN OIL COMPANY

505 PARK AVENUE

NEW YORK 22, NEW YORK

HELP WANTED

MAINTENANCE SUPERVISOR—Attractive opening with small, progressive, expanding, chemicals plant in Mid-Atlantic State. Excellent opportunity for ambitious, resourceful engineering graduate with past maintenance experience. The work is interesting, diversified, and includes both maintenance of existing equipment and construction of new facilities. Submit resume and salary requirement. Box J-185, The Oil and Gas Journal, Tulsa, Oklahoma.

PROCESS ENGINEER . . . for a modern independent refinery. Need man experienced in catalytic cracking. In reply give history of employment and education. Salary to commensurate with ability. Address . . . Superintendent, P. O. Box 6091, Indianapolis 20, Indiana.

PETROLEUM ENGINEERS

Major Oil Company has openings for graduate Junior and senior Petroleum Engineers in Production and Gas Operations in Venezuela. Salary commensurate with experience.

Please send details of experience

P. O. BOX NO. 35

BOWLING GREEN STATION.

NEW YORK 4, N.Y.

SAFETY DIRECTOR

to supervise the safety activities of natural gas transmission company. Location: Detroit. Must be willing to travel. Salary open. Include resume of experience and education. All applications treated confidentially.

Box J-182,

The Oil and Gas Journal,

Tulsa, Oklahoma.

HELP WANTED

GRADUATE PETROLEUM ENGINEER—Oil company has opening at Midland, Texas for aggressive field production engineer, under 38 years of age, with minimum of two years' west Texas experience plus proven ability in testing, drill stems, workovers and completions. P. O. Box 3053, Dallas, Texas.

DIVISION GEOLOGIST. Progressive Independent with Division Headquarters in Billings, Montana for operations in Montana, North Dakota, South Dakota and Wyoming has opening for Division Geologist. Must have 8 to 10 years experience in all phases of petroleum exploration with at least 3 years Rocky Mountain experience, preferably in Wyoming and Montana. Box J-187, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED—Subsurface geologist, with minimum 5 years experience in southern Arkansas and northern Louisiana, to be located in Shreveport. Box J-177, The Oil and Gas Journal, Tulsa, Oklahoma.

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FOREIGN EXPLORATION MANAGER. Geologist, experienced both Middle East and South America. Presently employed as major company exploration supervisor. Available to well financed independent planning extensive foreign exploration. Box J-172, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST. Nineteen years experience Oklahoma, Texas and San Juan Basin. Eleven years as District Geologist. Able to supervise Geological Department. Box J-188, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER—15 years excellent experience in domestic and foreign oil production covering both planning and operational phases of primary and secondary recovery. Positions held include assistant division reservoir engineer, chief petroleum engineer major producing company. Degree in geology. Desires affiliation with sound organization able to offer responsibility and opportunity for growth. Box J-169, The Oil and Gas Journal, Tulsa Oklahoma.

MICROPALEONTOLOGIST, Ph.D. geology, three years experience major oil company Texas Gulf Coast. Desire permanent location as paleontologist or geologist. Box J-171, The Oil and Gas Journal, Tulsa Oklahoma.

GEOLOGIST nine years West Texas experience with working knowledge of land and production available full or part time. Reply Box J-168, The Oil and Gas Journal Tulsa, Oklahoma.

AVAILABLE AT ONCE young man, BSc geology, 3 years middle East experience, M.Sc Palaeontology, 2 years experience Colombia, S. A., field work or research anywhere. Box J-198, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER, B. S. degree. Five years experience in Gas-Gasoline Plant and Refining. Diversified experience in Process, design, construction and water treating. Desire responsible position in same with small or medium sized aggressive company. Box J-199, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, petroleum engineer, production superintendent, 25 years experience, all phases oil business. Would like connection with small independent or company. Prefer Rocky Mtn. or Kansas. Now employed. L. A. Box J-195, The Oil and Gas Journal, Tulsa, Oklahoma.

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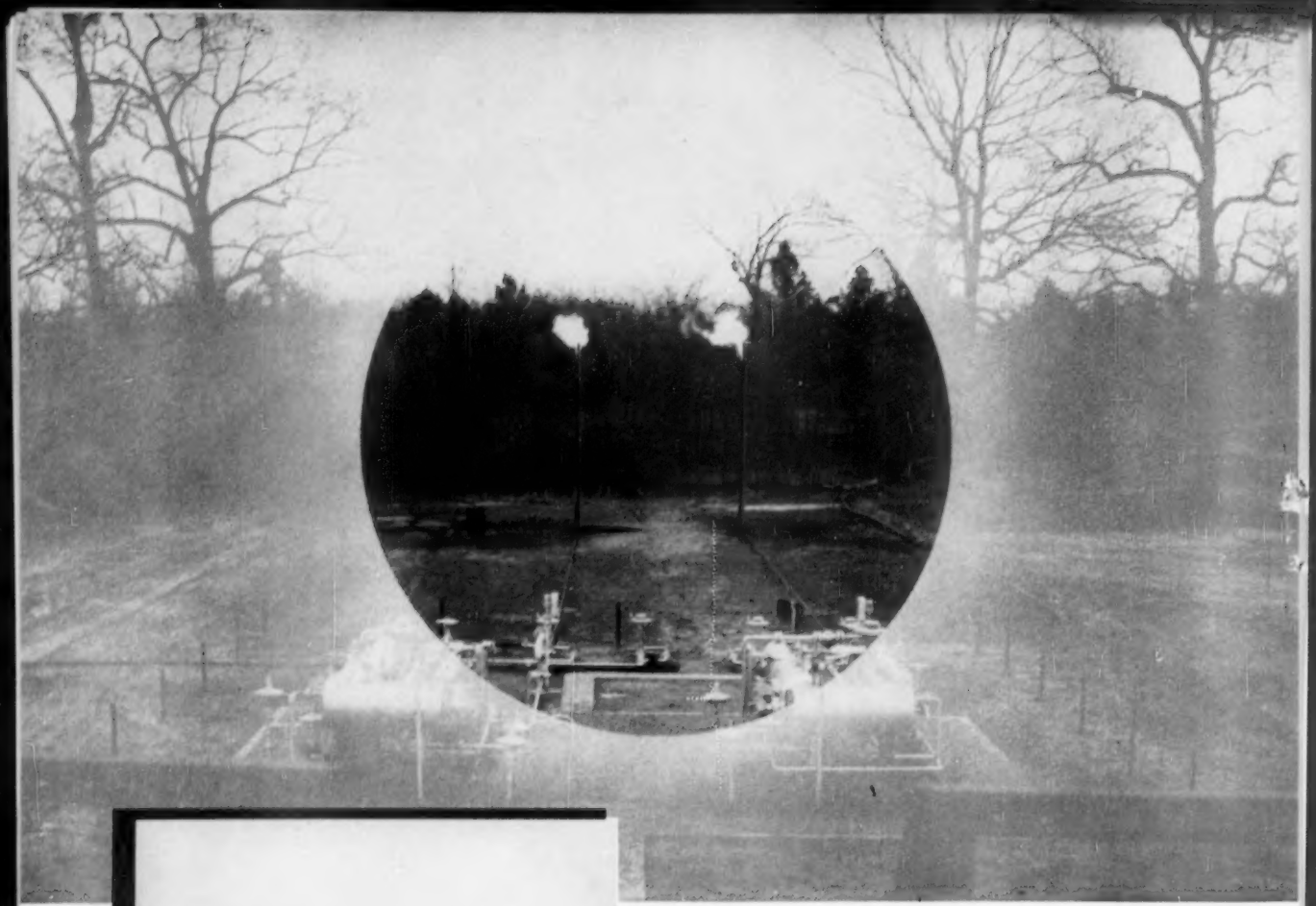

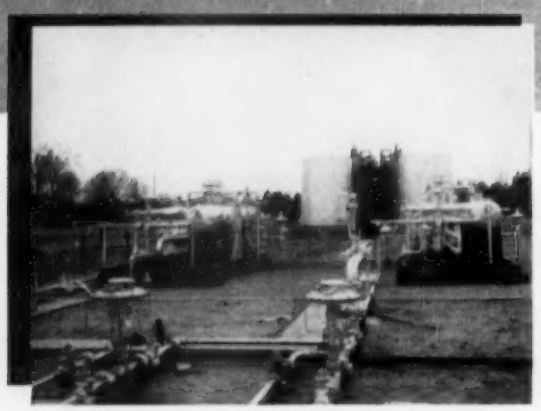

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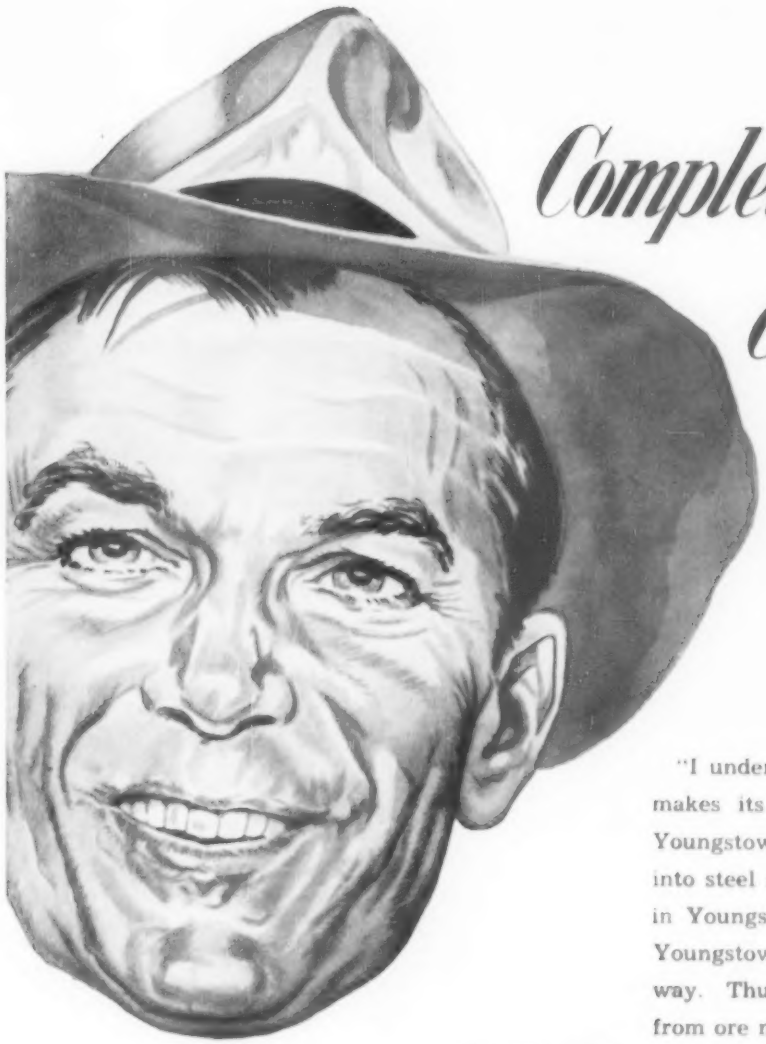

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